VETERINARY MEDICINE

Forestry

August, 1930

Contents

Parasites of Live Stock....312
The Los Angeles A. V. M. A. Meeting....313
Strongylidae of Horses....314
Mange of Horses....316
Equine Pediculosis....321
Mange in Cattle....322
Controlling the Kidney Worm of Swine....326
Stomach Worms of Sheep....328
Liver Flukes in Sheep....330
Tapeworms in Dogs....332
Follicular Mange of Dogs....334
Hookworm Disease of Dogs and Cats....336
Whipworm Disease of Dogs....337
Round Worms in Dogs....338
Parasites of Foxes....341
Salmon Poisoning in Dogs and Foxes....344
Recent Developments in the Importance and Control of the Intestinal Roundworm of Chickens....345
Coccidiosis of Fowls....346
Poultry Mites....348
Poultry Lice....349
Tapeworms in Poultry....351
At the Los Angeles A. V. M. A. Meeting....353
Entero-Hepatitis or Blackhead in Turkeys....354

No. 8
VOL. XXV

75 E. Wacker Drive
Chicago, U. S. A.

"the familiar Red Star"

Throughout the Veterinary profession today no mark means more than the familiar Red Star of Fort Dodge.

In every nook and cranny of the world where swine are raised it carries its assurance of absolute purity and potency.

It is relied upon by more than half the practicing Veterinarians of the United States alone.

No matter where your practice is, there is a Fort Dodge branch or agency near, ready to give you reliable and immediate service.

Specify **FORT DODGE**

Purchase with Confidence—Use with Pride

Fort Dodge Serum Co., U. S. Veterinary License 112, Fort Dodge, Iowa

We want every Veterinarian to be on our mailing list for a personal copy of the Fort Dodge Bio-Chemic Review. If you have not received the July issue, write us today.

Veterinary Medicine

VOL. XXV AUGUST, 1930 No. 8

Published Monthly by the Veterinary Magazine Corporation
75 East Wacker Drive, Chicago, Ill., U. S. A.
$4.00 a Year

Entered as second-class matter Nov. 8, 1920, at the post office at Chicago, Ill., under the Act of Mar. 3, 1879.
Entered as second-class matter under the title of American Journal of Veterinary Medicine, July 19, 1910, at Chicago, Illinois, under Act of March 3, 1879.

Copyrighted 1928, by Veterinary Magazine Corporation.
All matter appearing in this publication is covered by copyright, and no part of it may be reproduced without permission. Permission will be granted on request for the reproduction of anything in the columns of VETERINARY MEDICINE if the purpose of the reproduction is unobjectionable. Where there is any doubt as to the propriety of reproduction, the wishes of the author will be consulted.

D. M. Campbell, Editor A. T. Kinsley, Associate Editor

Parasites of Live Stock

THE extent of animal parasitism is all encompassing. The limits of materially harmful parasitism of animals in this country are unknown, but surely a larger number of animals suffer from harmful parasitisms than are visibly affected by all infectious diseases—bacterial, protozoan and filtrable virus—combined. Like the extent, the loss due to parasitisms of animals is unknown even approximately, but it is demonstratively greater than the loss from hog cholera, tuberculosis, infectious abortion, or any other infectious disease. On the whole, the extension of parasitisms is progressing; the loss is mounting. Indubitably, we are "losing the war on parasites of live stock," as Maurice C. Hall has pointed out so forcefully.

The typical attack of parasites is insidious. The losses they cause are but partially recognized. In but few instances are animal parasitisms important public health problems. For these reasons parasite control measures arouse little interest in legislative bodies, and are lacking in public support. The live stock industry is apathetic or in some degree antagonistic to comprehensive measures for parasite control or eradication. The successful parasite is the exemplar of the successful politician. It exploits its host only to a degree that the exploitation can be borne. It is wary of "killing the goose that lays the golden egg." The death of the parasitized animal is ordinarily an unfortunate accident for the parasite. It ends its career. Adaptation constantly strives to avoid this mishap. Tapeworms and flukes are exceptions to this plan and in them we find the exception —the intermediate host—the most vulnerable point of attack.

The losses from paratisism of live stock fall into four general classes:

1. The death of animals due to attacks of parasites: This is the most insignificant and at the same time the most generally recognized of the losses due to parasitisms. It occurs chiefly in young animals while the value is yet low. Informed fox raisers and dog breeders and swine producers and others will testify that this loss, small as it is, in comparison with the others, is yet very large.

2. The loss due to stunted growth, lessened milk, wool, meat and power production, and damage to meat and hides: This loss, although many times greater than that due to the death of animals from the attack of parasites, and furthermore readily capable of demonstration, has, until very recently, received almost no recognition by the live stock industry. Even now, the magnitude of this loss is little realized.

3. The loss of animals due to diseases that are parasite borne: In this category, of course, are included tick fever in cattle, and

blackhead in turkeys in this country, and a considerable list of tropical diseases. It includes also a considerable proportion of the anthrax, probably not an inconsiderable part of hog cholera, possibly anaplasmosis and, to a greater or lesser extent, various other infections. It is against only this class of losses due to parasitisms that we are winning the "war on parasites of live stock." This class of losses is decreasing. Associated as these losses are with the spectacular effects characteristic of virulent infections, sudden onset and swift destruction, it has been comparatively easy to enlist combative forces and to rout certain of these parasites over large areas.

4. The loss from infectious diseases due to lowered resistance in parasitized animals: Evidence is not wanting to show that this class of losses exists and that it may be very great, even the greatest of the losses due to parasitisms; but any estimate of the amount of such loss in dollars and cents, or even a comparison with other losses, falls into the realm of the speculative. There are those, however, who, not without reason, attempt to explain many of the vagaries of infections, particularly such infections as the influenzal diseases and hemorrhagic septicemia, upon varying degrees of parasitism in exposed animals. It is not necessary that all or most of the animals attacked in an outbreak of infectious diseases be parasitized severely to substantiate the charge that parasites are in part responsible for losses in some outbreaks of infectious diseases. As is well known, most pathogenic organisms possess the faculty of rapidly mounting in virulance when swiftly transplanted from one susceptible animal to another. Only three or four highly susceptible individuals may be sufficient to set off a latent infection already present in a herd with a virulence no contact can resist. That severe parasitism lowers the natural resistance of the animal is not questioned; that it may break down an artificially acquired immunity to canine distemper, for example, or to hog cholera, is generally admitted.

It will be recalled that Doctor Hall said we were *losing* the war on parasites of live stock; not that we have *lost* it. Nor is there a probability that we shall lose it. It is yet in its early phases. Parasitologists are devoting more effort to research than ever before. Regulatory officers are alert to the importance of recently developed parasite control measures. Veterinary practitioners are eager for more and new information on the subject. The live stock industry is beginning to appreciate the economic importance of parasites of live stock; to support appropriations for research and regulatory measures, and to call upon the practitioner for assistance in handling their individual parasite problems. And this is the quadric group that must fight the battles and win the war if it is won.

The general public may be expected to remain passive or indifferent. It is unlikely there will be public funds available to handle this project as a governmental one. Research must supply the information, regulatory officials the direction, the "private" practitioner must do the work and the live stock industry must cooperate with all three and likely shoulder the main burden of the cost, if measurable success is to be attained in the near future.

At the present time, interest in parasites of live stock is very much on the increase among veterinarians. No other subject was followed so attentively at veterinary short courses last winter as was the discussion of parasites; no articles in veterinary magazines elicit more discussion or incite more inquiries than those on parasites. Most of the information having practical application in parasite prevention, control and treatment is a product of the last 15 years. Much of it is naturally unavailable in textbooks. It is upon experiment station bulletins, and particularly upon veterinary periodicals, that dependence must be had for needed information on parasite control.

With a view to rendering available, in a convenient and condensed form, up-to-date information essential to handling parasite problems, VETERINARY MEDICINE has had prepared, by recognized authorities in this field, articles on the occurrence, life history, diagnosis, treatment, control and prevention

of the principal parasites of all live stock. The hope was to publish all of this in a single issue of the Magazine and thus simplify the search for it when such information is sought, which is usually when a problem requiring it is presented. However, much as condensation and elimination was practiced, it proved impossible to get all this material into a single issue, and since it is not deemed advisable to devote more than one issue of the magazine to any single phase of practice, that portion of this material not appearing in this issue will be published a few articles at a time in the next four or five issues. Perhaps at a later date, they may be collected and issued all together as a reprint.

THE LOS ANGELES A. V. M. A. MEETING

"Adam and Eve," imported 35 years ago from Capetown, South Africa when five years old, are among the 200 ostriches which visitors to the American Veterinary Medical Association at Los Angeles August 25-29 may see. The Los Angeles Ostrich Farm and the Cawston Farm, both within an hour's drive of the Ambassador Hotel, scene of the convention, each has about 100 birds on exhibition.

The four pound eggs worth $5 each and equal in food value to 25 hens' eggs with shells so thick it takes the young 24 hours to emerge are on view in the incubators where they remain 40-42 days. Visitors will see birds in all stages of growth from day old chicks weighing three pounds and valued at $25 to 250-350 pound adults with a stride of 22 feet and worth $300 and up.

"Cloudburst," the racing ostrich, will give even an old race horse fan a real thrill, when he paces around the track at 30 miles per hour.

Other places of interest to be seen by attending the L. A. meeting are:

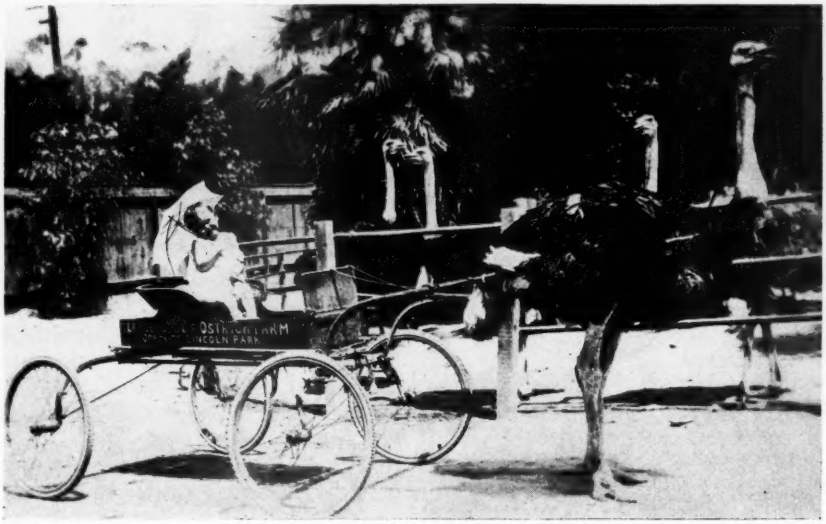
Veterinary hospitals (most modern dog and cat hospitals).

Motion picture studios and theatres, missions, museums, monkey farm, mountains.

Lion farm (only one of its kind), live stock ranches.

Airports, airplane factories, alligator farm, Angelus Temple, art galleries.

Golf courses and clubs, Grauman's Chinese theatre, La Brea fossil pits.



"Cloudburst" the Racing Ostrich.

Strongylidae

By W. GEO. TURNER, Colonel, V. C., U. S. Army

THE family Strongylidae is a large group of blood-sucking worms, including six genera common to the domesticated animals, viz.: Strongylus, Sclerostoma, Stephanurus, Syngamus, Esophagostoma and Uncinaria.

Strongylosis is a condition in which the animal is infested by some of the strongyles. There are five forms of strongylosis—bronchial, gastric, intestinal, vascular and renal. These strongyles infest such areas as are indicated by the foregoing names.

Wet seasons favor the development of the disease since moisture insures the life of the embryo outside the body of the animal. The disease is most prevalent in low-lying and swampy lands. It may be spread by the ova or embryos being carried in streams of water or by infested animals being introduced into a band, contamination occurring through food and water. The eggs hatch soon after their passage from the host, and the embryos remain alive for a long period of time if they are in a moist place.

Dr. M. C. Hall states that in his opinion parasitic diseases are approximately as important as bacterial diseases. The bacterial diseases are spectacular but they are more or less sporadic. They may be present at one time and absent for months or years, and they may be present at one place and absent at others at that time. On the other hand, the parasites may exist and be present at most places throughout the year and every year.

Strongyles of the Horse

In the group of parasites commonly known under the name of *Strongylus armatus,* the following three species are briefly discussed:

Sclerostomum equinum, S. edentatum, and *S. vulgaris.* All three species are usually found in the cecum and first portion of the large colon.

Sclerostomum equinum: This is the largest species of strongylus found in the intestines of the horse. The male measures up to 35mm long (1½ inches) and 1.25mm in thickness. The female measures up to 47mm long (2 inches) and 2.25mm in thickness. Three teeth are found within the mouth capsule.

Sclerostomum edentatum: This is the next largest species of strongylus. The measurements for both the male and female, respectively, are slightly under those given above. The head is distinctly divided from the body. The mouth is cup-shaped with no teeth-like projections.

Sclerostomum vulgaris: This is still smaller than the two species previously mentioned, and the mouth is slightly cup-shaped. This parasite is found principally in the cecum and at times in the colon, while the other two mentioned are usually found in the first portion of the colon.

The strongyles draw blood by aid of their chitinous mouth-capsule, and on account of this being buried in the mucosa it offers quite a resistance to traction in an effort to remove them. This group wanders through the body, and one species, *Strongylus vulgaris,* goes to the anterior mesenteric artery or other blood vessels, where it often produces an aneurism.

Symptoms

Clinical symptoms in sclerostomiasis of the intestines are produced when there is a heavy invasion by the mature parasites, and may last from one and one-half to two months. Many cases have been observed in colts in the late fall and early winter, after the colts have been placed on wet pastures. Infestation is characterized by poor development, loss of condition, and rough coat of hair, in spite of good care and feed. Circumscribed perspiration areas in the region

of the flank are often noticeable. The animal tires easily while at work. Occasionally intestinal sounds, foul-smelling soft stools and periodic attacks of colic are observed. In the more severe cases, there may be diminished appetite, and even food and water may be entirely refused, with progressive emaciation, staggering gait, anemia, and acceleration of the pulse. In addition to the foul-smelling diarrhea, a number of the parasites may be observed in the feces.

Diagnosis and Differential Diagnosis: The presence of the mature Sclerostomum in horses may be recognized on rectal examination, but the usual diagnosis is made upon the findings of the ova by microscopic examination of the feces. It is also of great value to make a careful physical examination of the animal and take into consideration all of the conditions of environment. In the differential diagnosis, one must not be confused by chronic intestinal catarrh of young animals, or infectious anemia, the latter being somewhat similar in its clinical characteristics.

In a group of 86 colts (25 yearlings, 30 two-year-olds, and 31 three-year-olds), 100% of them were infested with strongyles, a fair index of strongyles infestation in colts in the fall of the year.

Treatment

The line of treatment adopted by the Army for strongyles is as follows:

All food is withheld for 36 hours (give water only), except in the case of pregnant mares. The fast period is preferably so arranged that it will terminate in the morning, which is a desirable time for giving the anthelmintic. The medicament is given through a stomach tube. The regulation tube was found to be a little large for weanlings and yearlings, so a smaller tube, 9/16-inch outside diameter, was procured and proved extremely satisfactory; in fact, it has completely displaced the larger tube for the medication of horses of all ages. With the Army Veterinary Corps the stomach tube has come into its own and the drenching bottle is a thing of the past.

Oil of chenopodium: The dosage is computed by the weight of the animal 4cc (one dram) of oil of chenopodium to each 250 pounds of weight. Because of the uncertainty of the purity of raw linseed oil, equal parts of liquid petrolatum and castor oil are used. One pint of this mixture with the proper quantity of oil of chenopodium thoroughly incorporated, is given to weanlings, 1½ pints to two-year-olds, and one quart to three-year-olds and upwards.

Carbon tetrachlorid: This drug is approximately as efficient as the oil of chenopodium in the elimination of strongyles and, owing to its being less irritating and requiring no purgative, may be preferred. The dose of this agent is 50cc per 1,000 pounds weight. A small quantity of water may be added to increase the volume.

Pregnant Mares: On account of probable prenatal infestation, the treatment of mares in foal is an important factor. Carbon tetrachlorid has proved to be a most satisfactory agent for such use. The fasting period in the case of the pregnant mare should not be for more than 12 to 16 hours.

Age is no barrier to the parasitic invasion of horses. Colts and horses without characteristic manifestation of unthriftiness have been found to be heavily infested.

In the final analysis, the battle against any group of parasites becomes one of possible control and elimination. Treatment, while of vital importance to the individual animals, is a secondary consideration. Theoretically, at least, prevention is the paramount issue and this will involve thorough disinfection of stables, sprinkling of pastures with a chemical solution designed to destroy eggs and larvae with which it comes in contact, but one which will not harm the pasture, and rotation of pastures with reference to grazing as well as crops. The feeding of hay from racks rather than from the floor or ground, composting, screening, and chemical treatment of manure with a view to controlling the development of the larvae and the dissemination of these by flies would be a big step in control measures, and would materially reduce the flies.

Mange of Horses

By ARTHUR D. MARTIN, Captain, V. C., U. S. Army

MENTION of this disease appears in writings before the Christian Era, but no intelligent works were recorded before the beginning of the eighteenth century connecting the disease with the parasite which is the causative agent. Early continental wars record outbreaks among the animals which were used as beasts of burden and for transport, as well as transmission of the disease to their attendants. War and its attending hardships has ever furnished one of the most fertile fields of action for the mange parasite. Mange is widely distributed but thrives best in the temperate zone, being most prevalent in the winter months, no doubt due to the long winter coat of its host that afford the parasite added protection for its malevolent activities.

The disease is highly contagious and is reproduced by the tranmission of the parasite from one animal host to another. The parasite belongs to the family—Sarcoptidae, and those affecting the equine species are divided into three genera: the burrowing mite, Sarcoptes; the sucking mite, Psoroptes; and the scale eating mite, Symbiotes.

Occurrence

Few warm blooded animals are free from the ravages of the mange parasite, in one form or another. The space available will permit only a limited discussion of that group affecting the equine species, so much of which was encountered during the late war in the theater of operations. There is little doubt that in mange we have the most serious of the diseases affecting animals under campaign conditions from the standpoint of animal mortality and non-effectiveness.

The incidence of mange in some combat divisions went up to one hundred per cent during the period preceeding the armistice. While the disease is dependent upon the presence of the mange parasite, the contributing factors in its rapid spread are found under active campaign conditions. Many rules of ordinary peacetime behavior must be discarded. Exhaustion, lack of proper feeding, brought about by the shortage of forage and the absence of water; no shelter, or if available, badly contaminated and unsanitary, contributed to the lack of proper animal management, resulting in debility and consequential rapid spread of the disease.

Symptoms, Lesions and Diagnosis

The sarcoptic mites burrow in the outer dermal layers of the skin and feed upon the *rete malpighi* which contain plasma. The female deposits her eggs in these burrows and the secretions of the parasite produce an intense inflammation of the skin.

The psoroptic mites live on the outer surface of the skin and by means of their mouth apparatus or trophi, suck blood, serum, and lymph from it while clinging to the scales and hair. They also cause inflammation of the skin by pricking it, and intense itching.

The symbotic mites inhabit the outer skin surface and manifest their presence in much the same manner as the psoroptic mites.

The lesions and the results of mange are too well known to merit detailed discussion. Experience in handling and treatment of mange-infested animals is of greater interest.

Early diagnosis of the disease and prompt isolation of suspected cases are all essential in combating mange infestation. It is comparatively an easy matter to detect the mites of the psoroptic and symbotic varieties inasmuch as their location is on the surface of the skin. This is not so with the sarcoptic mites, their

habit of burrowing into the skin makes it necessary to remove the outer scabs and scales and to take deep skin scrapings from several locations of the affected surface. A careful examination must be made of these scrapings in order to detect the parasite. Low power magnification is essential to thoroughness. It is also worthy of note that two or more different types of mange infection may be co-existent in the same animal or group of animals.

Treatment

There are several methods that have proved effective in the treatment of mange, the application of a variety of drugs, oils, and combinations thereof, sulphur gas chamber, and others. But the treatment we are seeking is an effective agent that is not prohibitive in cost, one that may be adapted to hospital routine or for use under adverse field conditions, and at the same time will destroy the infection and return the animal to duty in the shortest possible period of time. We have such a well tried and proved preparation in calcium sulphid.

Mange became so generalized during the later stages of the World War, among our combat units, as to be almost commonplace, and for several months following the armistice a grand battle was waged by our veterinary personnel in order to gain the upper hand. The success of this fight is now a matter of history.

The dipping vat was our most valuable agent in treating large numbers of animals in our mange hospitals and at other strategic points where a great many animals were assembled. These vats were of concrete construction, jacketed with steam pipes to agitate the mixture and also to keep it warm, a feature which is most essential in using lime and sulphur compound (calcium sulphid). In preparing lime and sulphur compound the following should be the proportions, bearing in mind the fact that the solution should always be applied at a temperature of not less than 105° F., or more than 115° F.

Flower of Sulphur..... 24 pounds
Unslaked Lime..... 10 pounds
Water .....100 gallons

The lime should be slaked to form a rather thick lime paste, the flower of sulphur should then be added to this paste and well mixed. In a kettle containing from twenty-five to thirty gallons of boiling water, this mixture is added, a small amount at a time, and constantly stirred, then boiled for about two hours (three or four hours boiling makes the solution much stronger), being stirred at intervals. After the sulphur disappears from the surface the mixture, including the sediment, is poured into a barrel or vat having a spigot a few inches from the bottom. After being allowed to settle the liquid is drawn off through the spigot and enough warm water added to make one hundred gallons. The sediment remaining in the barrel or vat must not be used in treatment, but may be utilized to advantage in the disinfection of fences, corrals and stables.

In making large quantities of the solution the same proportions may be used, and in places where no dipping vat is available the same mixture may be applied with a hand spray followed by a man with a brush to rub the mixture in, or it may be applied by hand, the attendant holding the bottle with one hand and in the other a brush with which to rub in the mixture as applied.

The temperature of the mixture is just as important here as in the dipping vat, and while the contents of the vat may be kept at a fairly uniform temperature by application of steam, it will be necessary to provide some means of keeping warm the solution that is to be applied by hand.

Equally important is the maintenance of the proper density of the calcium sulphid solution. This is accomplished by constant use of the ordinary urinometer.

Specific gravity reading should be 1023.0 at the proper temperature for application (105°-115° F.). The reading of the urinometer should be 23.0 degrees. Should it sink below this reading the solution is too weak, that is, there is an insufficient amount of chemical products obtained by fusing of the lime and sulphur by boiling; more of the stock solution should be added so that the correct reading may be obtained. It may be the experience of the individual preparing the mixture that the formula will not produce the results indicated, but a careful check will reveal that there is still free sulphur in suspension. A continued boiling of the stock solution will give a product which on proper dilution will give a correct reading on the urinometer. When the solution is too strong the urinometer will not sink to the desired marking (23.0°) and will require additional dilution with water.

Contamination of the solution in the vat must be guarded against, and a complete change of solution should be made as often as necessary. Washing the animals' feet by turning a hose on them and other necessary measures may be practiced before dipping to decrease pollution of the dip.

Dealing with the problem of mange treatment from the viewpoint of an evacuation, convalescent or base hospital where fifty per cent or more of the animal patients admitted are infected, all should be considered contacts and should be clipped. The place where the clipping is done should be so arranged that it may be thoroughly disinfected and all hair should be burned. Each animal should receive a thorough inspection by the receiving veterinary officer in order to determine the initial treatment that each case should receive; for instance, there may be advanced or chronic cases that require loosening of the scurf and scabs by scrubbing with medicated soap in order that the medication to follow may be given an opportunity to do its work effectively. Medical and surgical cases should receive hand treatment.

The dipping vat was looked upon by our Allies in the World War with an expression akin to horror and was considered surely productively of much loss from pneumonia. This sequel to dipping is so rare, regardless of weather conditions, where the animals are properly housed and cared for, as to be almost negligible. Animals coming from the vat are scraped down to remove the surplus moisture and promptly blanketed. Under ordinary conditions no ill effects result.

Blanketing and the care of blankets in connection with routine treatment is a most essential step. Each animal dipped during inclement weather should be covered with a fresh blanket that has been disinfected; this may be accomplished without impairing the value or life of the blanket by subjecting each blanket prior to issue to a long period of exposure in a sulphur gas chamber. This chamber should be divided into several compartments so that a supply of fumigated blankets is always available. The gas chambers should be located in close proximity to the exit of the dipping vat, where most of the blanket issues take place.

The number of times and the amount of treatment each in-

dividual case receives will vary. The veterinary officer in charge of the ward will necessarily be governed by the condition of the animal, the extent of infection, and the fact that the eggs of the parasite hatch in from four to seven days; the parasites being capable of reproducing themselves in from fourteen to seventeen days. In some instances one good treatment either by hand or dipping vat method will suffice, while in others four or five such treatments may be necessary. Where large numbers of animals are being dipped it is good practice to dip each animal once each week, paying particular attention to progress of individuals, hygienic measures, and the possibilities of re-infection.

Other Treatment Less Effective

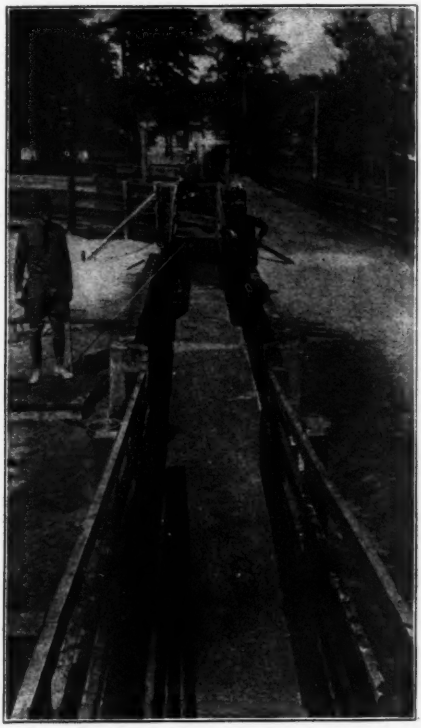
It is not the purpose of this paper to discuss the relative merits of other methods of treatment as compared with lime and sulphur, but no other procedure has yet been brought to the writer's attention that surpasses it in effectiveness under all conditions; as an agent that can be used equally well in the field or in hospital, applied by dipping or hand to either large or small groups of animals. Arsenical preparations have been used effectively but they have the added danger of absorption of toxic quantities of arsenic, resulting in fatalities. Sulphur gas chamber treatment has given excellent results under definite conditions, no more effective, however, than lime and sulphur, and not nearly so versatile. This method serves a more useful purpose as mentioned previously in fumigation of equipment that liquid disinfectants would destroy.

Prevention

Mange is associated with debility brought about by hardships and lack of care. Correction of this feature wins half of the battle. Well groomed and well cared for animals are not a fertile field for the activity of this parasite.

Due to the contagious nature of mange, constant vigilance on the part of the responsible veterinary officer in known infected territory is required to see that his animals are not unnecessarily exposed, such as being stabled in shelters which have been occupied by unknown animals, before the shelters have been thoroughly disinfected as a precautionary measure. When active cases have been found and segregated, the contacts and remaining animals should be carefully inspected each day as an added precaution. Interchange of equipment or attendants should not be permitted; individual grooming kits should be insisted upon and these kits should be disinfected after use.

As a routine protective measure animals may be clipped in early fall in order that their coats may be grown sufficiently to afford protection in the cold weather to follow. This practice is an aid to better body hygiene so essential to animal health.



Dipping Vat for Horses at Camp Hancock, Georgia.

Equine Pediculosis

By R. A. KELSER, Major, V. C., U. S. Army
Army Medical School, Washington, District of Columbia

PEDICULOSIS or lousiness in the lower animals is an affection which, once introduced, thrives among poorly groomed, improperly cared for animals maintained under questionable sanitary conditions. Undernourished, unthrifty animals serve as particularly excellent hosts for these pests but the condition is not, by any means, restricted to individuals in poor health as perfectly normal animals become infested if exposed and subsequently neglected. It is a fact, however, that the heaviest infestations are found in animals in poor condition.

In so far as the horse and mule are concerned there are three species of lice which attack such animals. Two are biting lice and the other a blood-sucking variety. Those which bite are *Trichodectes parumpilosus* (*Trichodectes equi*) and *Trichodectes pilosus,* while the single blood-sucking type is *Hematopinus asini* (*Hematopinus macrocephalus*). Of the biting lice *pilosus* is less common in the United States than *parumpilosus.* Infestation of horses and mules with the sucking variety of louse is much more common than with the biting varieties.

The biting lice are more active than the sucking lice and are considerably smaller in size. Apart from size the two types can be readily differentiated by examination of the head. The head of the sucking louse is elongated and narrower than the thorax whereas in the biting louse the head is more nearly round or square and is broader than the thorax.

The entire life cycle of the louse is spent upon the host animal and definite affinity for a particular host is marked. Thus, it seldom happens that a species of louse is found on any but the animal it regularly infests. The life histories of the biting and sucking lice are essentially the same. The eggs are laid and glued to the lower portions of the hair shafts and usually hatch in from 6 to 8 days. After undergoing four or five molts the young lice reach maturity in a little less than a month.

Symptoms

When attacking horses and mules the biting lice are prone to congregate in largest numbers upon the lower portion of the neck, in the sternal region, between the legs and on the abdomen. The sucking lice, on the other hand, seem to especially prefer areas at the base of the long hairs. Thus, they are found most numerous around the root of the tail and at the base of the mane and forelock.

The itching caused by lice is frequently extremely intense, especially when the sucking louse is the offender. This itching leads to rubbing which is sometimes carried to the point where considerable injury is done the skin and opens the way to infection with pyogenic organisms. Aside from actual injury to the skin and coat and the possibility of the conveyance of disease-producing organisms by lice, infested animals frequently become unthrifty, restless, irritable, and may even emaciate if the infestation is heavy.

Treatment

The treatment of pediculosis offers no particular difficulties provided it is carried out in a thorough manner and supplemented with proper sanitary measures to insure against reinfestation. Various parasiticidal agents have been advocated by different individuals. Ordinarily clipping the animal is a decided aid to treatment. This is not always possible with large groups of animals and neither is it advisable in very cold weather. However, when it is possible and feasible to clip, such procedure should be followed.

If large groups are to be treated the dipping vat, if available, obviously, facilitates

handling the animals. Liquor cresolis compositus or creolin (2 to 2.5%) is probably the most frequently employed agent where dipping vats are used but is not necessarily the best. Nicotin solution (0.05%), bichlorid of mercury (1 to 1500), arsenical dip (8 lbs. arsenic trioxid, 24 lbs. sodium carbonate, 1 gal. pine tar to each 500 gal. water), and the standard lime-and-sulphur dip employed by the army for the treatment of mange are all effective in the treatment of lice.

Where the nicotin, mercury or arsenical dips are employed great care must be exercised to prevent poisoning of the animals. Animals subjected to such dips should be watered before dipping and should be permitted to drain in a place where there will be no danger of the dip solution contaminating a food or water supply.

Lice can also be successfully treated by fumigation of the animal in a specially constructed fumigation chamber. In such a chamber all portions of the animal's body with the exception of the head are subjected to the action of sulphur dioxid. In generating the sulphur dioxid 35 grams of sulphur should be used for every 30 cubic feet of space within the fumigation chamber.

Oil emulsions (kerosene, linseed oil, etc.) are of value in the treatment of lousiness but such preparations must be used with care on account of their depilatory action.

Where only a few animals are to be treated, hand treatment is satisfactory and is often found to be more thorough than dipping. In the case of biting lice and where only a few animals are to be treated, sodium fluorid dusted into the coat gives satisfactory results. Such treatment is of no avail in eradicating the sucking species.

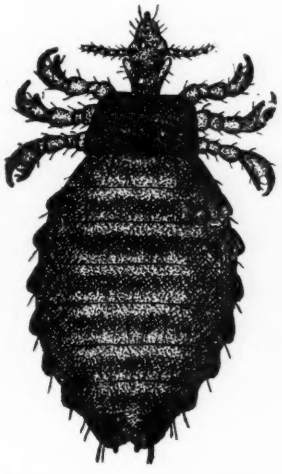
Disinfestation of Quarters

The treatment for pediculosis should be repeated at least once after 10 days or two weeks.

After treating animals for lice their equipment and quarters must be thoroughly cleaned if immediate reinfestation is to be avoided. All litter should be burned; harness, brushes, combs, etc. should be washed with a suitable disinfecting solution. Blankets may be first washed or soaked in a disinfecting solution and subsequently rinsed out in water or if a sterilizer is available they may be sterilized without washing. Stalls, stable walls, etc. should be sprayed or whitewashed. In spraying stables it is best to employ one of the less poisonous solutions.

Prevention

As is the case in the human family, pediculosis, in the vast percentage of cases, bespeaks carelessness in ordinary, everyday hygiene. Thus, horses and mules regularly and properly groomed and maintained under suitable sanitary conditions are not likely to be found suffering from lousiness. In this connection it should be remembered that lice, if given the opportunity, are more likely to establish themselves in cold weather when the animals' coats are long and heavy. It is during the winter months, therefore, that particular care should be taken to insure that there is no let up on proper grooming.



Horse Louse — Hematopinus Asini (Female).

Mange in Cattle

By W. J. BUTLER, Helena, Montana

MANGE or scabies is a contagious skin disease and was known in ancient times, but it was not until 1812 that Gohler discovered the scab parasite of cattle.

The disease in some one variety or another is to be found in practically every country in the world. It is doubtful if some variety of mange is not to be found in every state in the United States. The common psoroptic variety of the disease in cattle however is reported as existing only in nineteen states of the United States.

There are three varieties of cattle mange caused by the Sarcoptidae mites, sarcoptic, psoroptic and symbiotic mange. There is also a follicular mange caused by the *Demodex folliculorum bovis.*

Identification of Scab Mites

The *Sarcoptes scabiei bovis,* the mite that causes sarcoptic mange is smaller and rounder than the *Psoroptes communis bovis,* the mite that causes psoroptic or the common mange of cattle. The female measures about one-fiftieth and the male one-sixtieth as compared to one-fortieth and one-fiftieth of an inch respectively for the psoroptic mites. These scab mites have four pairs of legs. In the sarcoptic mite the legs are short and thick and the suckers are confined to the four front legs and only one filament projects from the end of each of the four hind legs. In the psoroptic mite the legs as well as the head are longer than in the sarcoptic mite. In the psoroptic mite there are suckers on each of the four front legs as well as on the fourth or last leg on each side. The third leg on each side has two filaments. It is by these two very characteristic differences (sucker on the fourth or last leg on each side and two filaments projecting from the third leg on each side as against no suckers on the last leg and only one filament projecting from the third leg) that the psoroptic mite may be differentiated from the sarcoptic mite.

The chorioptic or symbiotic scab mite is very similar to the psoroptic mite. The number of suckers and filaments are the same. The mite however is slightly smaller and more elongated or oval and its legs much thinner.

Habits and Viability of Scab Mites

Scab mites are yellowish in color and are visible to the naked eye especially when warmed (they become more active when warmed) and placed on a dark background such as a piece of carbon paper.

The entire life cycle of these scab mites is passed on the body of the animal host.

Under northwestern range conditions, mange, in the majority of cases, becomes dormant during the summer months. It does not cure itself but the mites become inactive. If affected animals however are shipped or held in close confinement the disease in a very short time again will become evident. If affected animals are held under range conditions the disease will make its appearance and spread with considerale rapidity during the winter months. The most favorable time to detect mange under northwestern range conditions is during January and February.

There is some question as to the length of time under natural conditions that the scab mite will live detached from the living host animal. We have personally observed living scab mites on the pelt of a wild Rocky Mountain sheep (Big Horn) eight days after the animal had been found dead and the pelt removed and this during the late winter months with snow still on the ground.

We are inclined to believe, however, that scab mites when removed from the host animal do not live very long. We are of the opinion that the disease, in the great majority of cases, is spread by direct contact with affected animals rather than by in-

fection picked up in corrals and by rubbing on fence poles. For this reason too great stress cannot be placed on the absolute necessity of careful and effective dipping.

Sarcoptic Mange

This variety of mange is caused by the *Sarcoptes scabiei bovis*. It is sometimes called barn itch and is undoubtedly spreading in the United States. It is quite frequently observed in pure bred cattle and is not uncommon in show herds. Constant grooming and oiling keeps the disease in such animals under control and in many instances is not observed by innocent purchasers. This mite burrows under the skin and excavates burrows or galleries where mating occurs and eggs are laid. It does not spread as rapidly as psoroptic mange but is more difficult to cure. It is a serious disease, and when it occurs in range cattle if not promptly and effectively handled will financially embarrass if it does not break the cattle grower.

Hutyra and Marek report this disease as being transmitted from horses to cattle. In this western country we have had, particularly on Indian reservations, extensive outbreaks of sarcoptic mange in horses. We have never known of it being transmitted from horses to cattle even though the cattle were on the same range and were handled in the same corrals as were the scabby horses.

The sarcoptic mite attacks that portion of the body where the hair is fine and scanty and the skin tender. The inner surfaces of the thighs, the belly and the brisket or under side of the neck but particularly the inner surfaces of the thighs is ordinarily where the disease first will be observed. If not properly treated the disease may spread over the entire body.

The disease is associated with intense itching and unthriftiness. Small papillae are formed. The skin becomes inflamed, swollen and wrinkled and as the disease progresses takes on the appearance of an elephant hide. The hair on the affected areas drops out, the animal rubs itself, and raw surfaces which become covered with a yellowish dry serum make their appearance.

In securing scrapings of the sarcoptic mange mite for the demonstration, dip deep into the bottom of the furrows caused by the wrinkles. Draw blood if necessary. It is in the galleries underneath the furrows that the most mites are found.

The sarcoptic mite eggs hatch in an average of from four to five days. The young female reaches maturity and begins laying eggs in from ten to twelve days.

Because the mites burrow beneath the skin, and since dips may not penetrate sufficiently to kill all mites, more dippings are required for sarcoptic mange than for psoroptic mange.

The interval between dippings for the cure of sarcoptic mange is given as from six to ten days. Our experience has led us to place the interval between dippings at from five to seven days.

Psoroptic Mange

The common mange of cattle is caused by the *Psoroptes communis bovis*. It is not as severe on cattle as sarcoptic mange but it is bad enough and causes large annual losses to the cattle industry.

This mite prefers that part of the body covered with hair—the withers, neck, back and root of the tail. If not treated it may spread over the entire body. The mite does not burrow like the sarcoptic mite but it causes severe inflammation of the skin, itchiness and the formation of papules. Affected parts become denuded of hair; scabs covered with a dirty yellowish serum and streaked with blood are formed.

The female of the *Psoroptes communis bovis* lays from fifteen to twenty-five eggs. These eggs on the host hatch after four to seven days incubation. The newly hatched female mites lay eggs in from ten to twelve days.

The interval between dippings for the cure of psoroptic mange is from ten to twelve days, with the outside limit ten to fourteen days.

Psoroptic mange is not transmitted from one species to another. Sheep and cattle each have their own particular mite and al-

though they cannot be told apart by the ordinary field or laboratory worker the sheep mite will not affect cattle and *vice versa.*

Chorioptic or Symbiotic Mange

The common tail mange is caused by the *Chorioptes bovis bovis.* It develops slowly. It localizes itself and does not spread over the entire body. It is not transmitted from one species to another. The mite lives on the surface of the host body. Its life cycle is similar to the psoroptic mite and its treatment is the same as for psoroptic mange.

Treatment of Mange

Dipping with a recognized dip is the most effective method for curing mange.

Hand treatment is tedious and burdensome. It may be practiced where one or two animals are to be treated but cannot be recommended where a number of animals are to be treated, although as an added precaution all visible scab lesions should be hand treated just previous to the animal's being dipped.

There are two kinds of dipping vats. A cage vat where the animal is lowered into the dip and a swimming vat. Plans for dipping vats may be secured from the United States Bureau of Animal Industry or the various state live stock sanitary boards.

We like the cage vat for pure-bred cattle and small farm or ranch herds. We prefer the swimming vat where large numbers of cattle are to be dipped.

Lime and Sulphur Dip

We believe the best all around dip is lime and sulphur. It may be purchased from various supply houses in either the concentrated liquid or dry form and from these concentrated forms diluted at the vat to the proper strength. It is seldom if ever made nowadays by boiling lime and sulphur at the vat. That is too tedious. The concentrated forms are more practical, less trouble and just about as cheap.

This dip is heated to 100° to 105° F. At the proper strength it contains 2% sulphur sulphid. Affected animals should be held in the solution for two minutes; exposed animals one minute. Two dippings at ten to twelve day intervals are required for curing psoroptic mange and four dippings at five to seven day intervals are required for sarcoptic mange.
amount of sulphur sulphid in the dipping solution.

Nicotin Dip

Nicotin is also a reliable and recognized dip. It is used to a considerable extent in districts removed from the railroad. It is inexpensive. A ten-pound can makes approximately 900 gallons of dipping solution. The dipping solution should contain from 0.05 to 0.06% nicotin sulphate.

There is a field test for determining the amount of nicotin sulphate in the dipping solution.

This dip is also heated to 100° to 105° F. Affected animals are held in the solution two minutes and exposed animals not less than one minute. Two dippings at ten to twelve-day intervals are required for psoroptic mange. While this dip is recognized for sarcoptic mange the writer does not use it in curing sarcoptic mange.

Oil and Oil Emulsions

Crude oil is hard on cattle and we do not recommend its use.

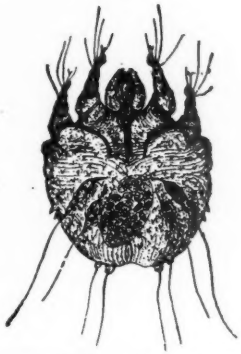
In Montana we do recommend the use of an oil emulsion where the oil used has a paraffin base.

The Preparation of Crude Oil Emulsion

The making of crude oil emulsion in the field; either by hand or mechanical devices, offers no particular difficulties. In making for instance 50 gallons of 50% emulsion it requires the following quantities of material and procedure.

Into a five gallon wash boiler are placed seven to eight ounces of lye and 7.5 pounds rosin in small pieces or powder and two gallons of water. The mixture is boiled until all rosin is dissolved and a clear brown liquid obtained. While preparing the above put two gallons of cold crude Cat Creek Oil (or any other natural crude oil with a paraffin base) in a 50-gallon barrel, which

is provided with a plunger made of a broom handle with two perforated cross pieces of one inch thick boards. Pour the hot solution of lye and rosin into the barrel containing the crude oil and agitate with the plunger for a few minutes then add one gallon of *cold* water, agitating the mixtures all the time by an up and down motion. At this stage of the process a yellow mixture resembling cream mixed with coffee will result. Keep agitating adding two or more gallons oil and one gallon cold water and repeat this until 25 gallons of oil have been incorporated and the emulsion made up with water to measure 50 gallons.



Mange Parasite — Sarcoptes Scabei.

It is the oil in the emulsion which has to do the work of killing the scab mite and therefore the emulsion should be kept to the desired strength of oil during the entire dipping process.

The oil emulsion dip is not heated, neither are the animals held in the solution. A simple complete immersion is sufficient.

In treating sarcoptic mange three or four dippings in a 50% oil emulsion solution at from five to seven-day intervals are recommended. Exposed animal, two dippings.

In treating psoroptic mange two dippings at ten to twelve-day intervals of visibly affected animals and one dipping of exposed animals in a 40% oil emulsion solution is recommended.

Coal Tar Preparations

Coal tar dips are not recommended as they are apt to make clumpy or not true emulsions. There is no field test for determining the strength of coal tar dips.

Thoroughness Essential

In curing mange it is absolutely essential to dip all animals in the exposed or affected herd. Sorting and dipping only visibly affected animals may hold the disease in check but will seldom if ever eradicate it. We believe that, under range conditions, diseased and exposed animals should be treated alike. The last animal dipped must be treated just as effectively as the first animal. This is easier said than done when a considerable number of cattle are being dipped. It is rather difficult to convince an owner that it is necessary to clean and recharge a large vat when there are only fifty or one hundred more cattle to be dipped. Yet it is the failure to properly dip all cattle and especially the last few that is responsible in a number of instances for failure.

One scabby animal not properly dipped will nullify the work of an entire dipping, be the number of cattle dipped one or ten thousand or more.

Stables, barns, corrals and sheds which have contained scabby cattle should be cleaned and disinfected.

Affected herds should not be permitted to come in contact with clean herds.

Follicular (Demodetic) Mange

This is caused by the *Demodex folliculorum bovis* and is the most serious variety of mange. As yet it is uncommon in cattle although reported as becoming more prevalent. We have never seen a case of follicular mange in Montana cattle.

It is reported that its progress is slow. Lesions are observed first in the neck and shoulders in the form of small spherical lumps which increase in size and coalesce, finally breaking and discharging a creamy purulent material. The formation and breaking of these lumps may cover a period of several years.

There is no satisfactory treatment or cure reported for follicular mange in cattle.

Controlling the Kidney Worm of Swine

By E. M. NIGHBERT, Moultrie, Georgia
Associate Veterinarian, Zoological Division, B. A. I., U. S. Department of Agriculture

THE kidney worm, *Stephanurus dentatus*, causes heavy loss to swine growers and packers in the southern states. This parasite occurs also in Connecticut and may be established in native swine in some localities of the middle-western states, but most of the Middlewest is still free from it. The kidney worm is most important in the South and Southwest, but the worm is able to accommodate itself, under favorable conditions, to the colder sections of the country.

Early observers thought the swine kidney worm did little injury to the host animal when confined to the perirenal region. Schwartz and Price in 1929 demonstrated that the parasite caused serious injury to growth and development in young pigs, when these are experimentally infected with cultures of the larval worms. The injury is caused in part during the migrations of the parasite, resulting in serious pathological changes in the organs invaded by the worm.

The favorable location in the host animal for the kidney worm to develop to maturity is in the fat and other tissues about the kidneys. It requires six months, according to Schwartz and Price, from the time the pig is infected, for the worm to reach the kidneys and settle down for growth to maturity. These findings have been confirmed by the writer in necropsies of pigs in the field under natural conditions.

Life Cycle

The matured male and female mate in the pockets or nests formed by the worm in the kidney region. Small canals lead from the hilus and ureters of the kidneys to the pockets. The precise method by which these canals are formed is unknown. The eggs pass from the pockets through the canals to the urinary bladder, and are voided with the urine. The eggs hatch on soil, pasture, etc. The immature larval worms infect pigs by being swallowed with the food and water, and by entering through lesions that may be on the skin. Schwartz was unable to infect pigs through the intact skin. Upon reaching the alimentary tract after being swallowed, the worms bore out and enter the circulation and invade the liver, causing serious pathological changes in this organ. The parasite is also commonly found in the lungs, in which cases small hemorrhagic spots are observed in the lung tissue. The parasite may be found wandering about in the thoracic and abdominal cavities. The kidney worm infests swine at any age. The parasite has been found in the livers of calves and adult cattle.

Losses Due to Kidney Worms

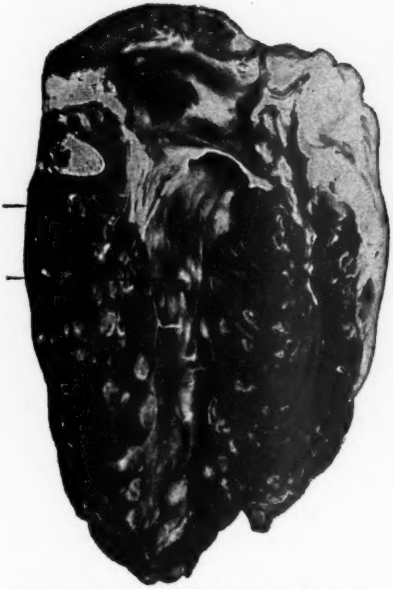
The kidney worm is wide-spread in the southern states. This information is based on findings reported from federally-inspected packing plants. The parasite has been found in some stage of development in every herd which has been studied by the writer and his associates. The liver, pancreas, kidneys, kidney fat and muscles of the lumbar region, all of which are commonly invaded by the parasite, develop inflammatory conditions which are localized, causing abscess formation and much scar tissue, making it necessary to condemn these otherwise edible products at time of slaughter. These losses are indirectly imposed upon the swine grower. Considering these losses in connection with the injury to growth and development of young pigs, there is ample evidence that kidney worms cause a loss of millions of dollars annually to the swine industry of the southern states.

Control Measures

There is much to be learned about kidney worms before satisfactory control measures may be laid down as established procedures for controlling the presence and spread of the parasites. The adoption of sanitation methods in raising pigs offers the only hope at present of controlling these worms.

Pigs should be farrowed in clean high, well drained fields that have not been used by swine for a year, or in fields which have been plowed and a cultivated crop grown on them. The pigs should remain on these or some other similar clean fields until finished for market.

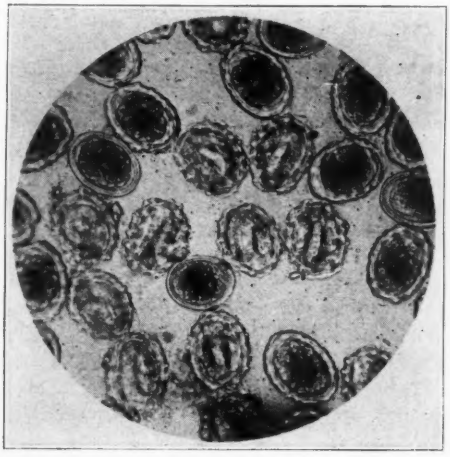
The next step is to provide sanitary watering facilities, and to use self-feeders in creep pens during the suckling period. These practical facilities make it possible



Section of a measly hog heart—Ostertag

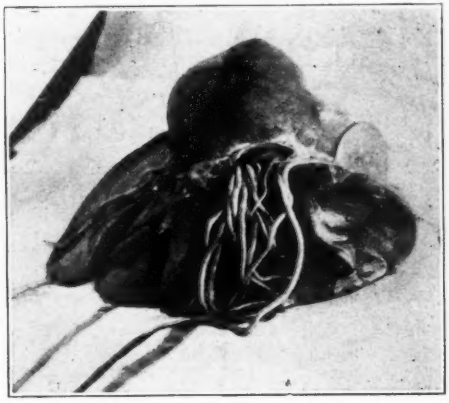
for the pigs to escape much of the infection that may be spread by infested sows. These measures, with properly balanced rations, including a mineral mixture of ground lime rock and common salt, equal parts, with enough tankage to flavor the mixture, aid in producing rapid growth and development, so that the pigs may be finished for market at the early age of six or seven months. This method hits the known weak points in the life cycle of the parasite.

In an initial test with eleven pigs farrowed and raised under the above methods, the post-mortem examination at time of slaughter showed seven of the pigs free from kidney worms in the liver, and four with only slight scars, probably due to kidney worms; thus 63.6 per cent of the pigs were free and 36.4 per cent were infested with kidney worms in the liver. All the



Vermiform embryos of Ascaris lumbricoides within the eggshell. In this stage of development the ova will infect when swallowed by a suitable host

pigs were found free of kidney worms in the kidney region, thus the pigs were 100 per cent free from the parasite in the carcass. At time of slaughter the average age of the pigs was 6 months and 24 days. The



Ascarid Infestation of Liver of Hog

average weight was 197.7 pounds. Raising pigs under the sanitary method was profitable.

Stomach Worms in Sheep

By R. E. REBRASSIER, Columbus, Ohio
Parasitologist, Ohio Agricultural Experiment Station
and The College of Veterinary Medicine, Ohio State University

THOSE familiar with sheep production are fully aware of the damage caused by parasites to which sheep are hosts. Of the parasites which infect sheep, one causing much concern is the stomach worm, *Hemonchus contortus*. It is commonly called the "sheep stomach worm" or "twisted wireworm." Taxonomically *H. contortus* belongs to the largest of the eight grand divisions of the Eunematoda, or true nematodes, namely the super-family Strongyloidea. Within this family are included many of the familiar parasites infesting the intestinal tract of animals, such as the smaller stomach worms of ruminants and the hook worms of man and other mammals.

Description and Life Cycle

The adult stomach worms vary according to the sex. The female is the longer, the average length being 37mm or about one and one-half inches and about the thickness of a fine needle. It is the female that has been called the "twisted stomach worm" because of the white ovaries being wound around the dark colored intestine. The male is shorter in length, being about 17mm. It is pinkish in color and does not have the twisted appearance of the female.

Life Cycle

The life history of the stomach worm is divided into four distinct stages: the ovum, embryo, larva and adult.

The mature female worm, after fertilization, deposits thousands of ova which pass from the host with the feces. These ova undergo only slight change until they reach the ground, and at this time, if favorable conditions exist, they develop, in a few hours, into tiny embryos. These embryos usually hatch in from ten to fifteen hours into tiny immature larvae about one-hundredth of an inch in length. After hatching, the larval worms live and develop in the feces or soil. Warm, wet weather is the most suitable for the hatching and development of the young worms. The embryos and young larvae are very sensitive to adverse conditions of temperature and moisture. They remain dormant or develop very slowly during dry weather, or when the temperature is below 40° F. Extreme dryness or a freezing temperature is fatal to them. Sheep are not infected by the larvae in this stage of their development.

After a short period, depending on external conditions, the immature larvae develop into what is called the "ensheathed form." At this period the larvae have grown a skin that is hard and very resistant. It is at this stage that they are infective for sheep, who take them into the digestive tract with food and water.

After reaching the abomasum, the larvae continue their development and reach the adult stage in about eighteen days.

The length of time mature larvae live on pasture has not been definitely determined. Some investigators have found pastures infective after a lapse of eight months, while some have reported infection occurring after a period of seventeen months. Sudden climatic changes, high summer temperatures, and the rapidity with which the moisture dries, are all factors to be taken into consideration. It is quite probable that under the above conditions, most stomach worm larvae do not survive much longer than eight or ten months and still retain enough vitality to continue development, if taken in by its host.

Sources of Infection

The sources through which sheep and lambs become infected are many. Probably the most common source is from vegetation taken in by the animals in grazing. Some of the ova and larvae may be carried in drainage water to ponds or pools, where

they develop to the infectious stage and are swallowed by the host while drinking. It is also reasonable to suspect that young lambs, while nursing, may obtain some mature larvae from the udder and wool locks of their dams.

The most severe infections usually occur during warm, wet seasons or when sheep are pastured on low swampy land. Lambs and yearlings suffer more severely than do older sheep.

Symptoms

It is estimated that the sheep stomach worm causes the death of from one to 50% of the average flock of sheep. Many sheep raisers have given up sheep raising because they could not control this parasite.

The first symptoms usually shown by infected sheep are dullness and lack of thrift. As the disease progresses the animal exhibits diarrhea and emaciation. The wool coat assumes a dry and harsh appearance and the skin and visible mucous membrane show a marked pallor. In late stages of the disease characteristic edematous swellings appear on the lower jaw and lips and occasionally in the region of the umbilicus. The appetite remains good and thirst is usually evidenced. Finally the animal becomes so weak that it cannot rise, and death occurs after a period of coma. The disease may run a rapid course, or weeks and months may elapse between the time of the first appearance of the symptoms and death.

A positive diagnosis of the disease may be made by an autopsy examination of the fourth stomach of a sheep or lamb showing marked symptoms. The fourth stomach should be opened its entire length, being careful not to lose its contents. The worms are small and in many cases they resemble the color of the mucous membrane, and therefore may be overlooked. If they are present in any considerable number, they are readily seen adhering to the folds of the mucous membrane of the stomach or exhibiting undulating movements in the liquid contents.

Control and Treatment

The successful treatment for the control of the sheep stomach worm should be relatively cheap, so that the cost of control will not be more expensive than the damage done by the parasite. It must also be a preparation that will be effective against the parasite and not damaging to the animal.

A satisfactory treatment for the elimination of the stomach worm is the use of a 1.5 per cent copper sulphate solution. This is prepared by dissolving two ounces of freshly powdered blue crystals of copper sulphate (C. P. grade) in one gallon of distilled water. The dose of the solution for young lambs about three months of age is 30cc. For yearlings and older sheep this dose may be increased to 60cc.

It is very desirable to protect lambs against infestation with this parasite, but under the usual farm conditions this is very difficult to accomplish. On the average farm it appears to be the best plan to attempt to keep these parasites under control so that they do not interfere with wool and mutton production. This may be done, even when lambs are placed on infected pasture, by treating with copper sulphate solution as described above.

The lambs should be treated at monthly intervals during the pasturing season, beginning at weaning time and continuing every thirty days throughout this season.

While the above method of management will not eradicate the stomach worm from the flock, it will keep this parasite under control and the losses that are caused by it will be prevented.

The gregariousness of sheep adds to the prevalence, extension and seriousness of parasitic infestation in this animal. Next to horses, sheep are the most parasitized of domesticated animals, and the only domestic animal in which the loss from parasities is probably greater than that from all infectious diseases combined.

Liver Flukes in Sheep

By J. N. SHAW, Corvallis, Oregon

FASCIOLA HEPATICA is the common liver fluke of sheep, goats and cattle. There are other flukes found in the liver of sheep but this paper will deal only with *F. hepatica* because it is the most common and causes the greatest losses.

Distribution

Contrary to popular conception this parasite has rather a wide distribution. It offers a real problem to the sheep men of Washington, Idaho, Nevada, Oregon, California, and Texas, and is found in Louisiana, Montana, Colorado. It has been reported from Michigan also.

Life Cycle

The life history of the parasite in Europe has been known for years. The snail host (*Galba bulimoides* Lea) in this country was found for the first time by the author in the late summer of 1928. This snail is very similar to the European snail host.

Symptoms

The symptoms of this disease in sheep vary according to the form of disease present. In some of the old countries four different forms have been recognized, the so-called acute where great numbers of immature parasites are present, the more or less chronic form where the parasites are mature and in the bile ducts, the form where immature parasites prepare the field for invading organisms and the so-called anaphylaxis form. It is thought all of these forms are responsible for losses in this country.

In the so-called acute form the sheep die suddenly while in good flesh. A few animals may have wattles under the jaw and a good many will have pot bellies. Anemia is not generally apparent. The ascites becomes evident upon handling the animal. In the chronic form there is a anemia, loss of flesh, weakness, often scours, and wattles under the jaws. Where sheep are dying of secondary infection the symptoms may be entirely absent and diagnosis must be made chiefly on autopsy finding. The writer is not sufficiently familiar with the anaphylaxis form to describe the symptoms.

Lesions

The lesions also vary according to the form of disease present. In the acute type the principal lesion is the discolored and roughened surface of the liver, the roughened abdominal surface of the diaphragm and the large amount of fluid in the abdomen. Great numbers of immature parasites are present throughout the liver tissue.

Where the chronic form is present the principal lesion will be the enlarged and thickened bile ducts which will be found containing large numbers of mature parasites. Considerable cirrhosis is remarked.

The lesions in the form where invading bacteria are producing damage are chiefly the necrotic areas in the liver with accompanying lesions of septicemia.

Differential Diagnosis

Differentiating between the different forms of the disease and other diseases affecting sheep is not an easy matter. History, temperature, lesions upon autopsy and the finding of the causative agent are important things to consider.

Treatment

Knowledge of the disease produced by this parasite has been in existence for many centuries, but it is only recently that a successful treatment and method of control has been worked out.

The treatment developed by R. F. Montgomerie of Wales is very efficient. The administration of 1cc carbon tetrachlorid will destroy every mature parasite present in the liver. It will not destroy immature parasites in this dose. Doctor Montgomerie found 10cc necessary to destroy flukes five

weeks old. If they had been present in the liver eight weeks 5cc would destroy them.

Some sheep have shown a susceptibility to carbon tetrachlorid even in 1cc doses. Some of these animals were pasture fed. The toxic dose usually is many times greater than 1cc.

The treatment is both cheap and very easily administered and results are very positive. It is always advisable to determine susceptibility by treating a few animals before treating the entire flock.

Control and Prevention

Old methods of control and prevention called for abandonment of fluke infested pastures. The use of copper sulphate together with drainage will, when coupled with treatment of infested animals, make it possible to continue the use of such pastures.

Any methods of control must take into consideration the life history of the parasite and until 1928 the intermediate host had not been determined for this continent.

Copper sulphate, when applied as a dust at the rate of thirty pounds to the acre, will kill as high as 99% of snails present. The efficiency of the blue stone will depend on type of pasture. It can be applied in many ways but one is to mix one part of land plaster with eight parts of blue stone. The land plaster serves as a vehicle and it also definitely outlines land that has been treated. Treatment of average fluke infested land can be made at a cost of about five dollars per acre.

Pastures should be treated when snails are present in greatest numbers. The biology of the *Galba bulimoides* Lea has yet to be worked out but they are very numerous in early spring and this is at least one time when pastures could be treated. Snail eggs are deposited throughout the warm months so more than one treatment would be necessary.

Some work has been done to determine the danger to stock of treated pastures. So far it seems that the danger is very slight. The British recommend that animals be kept off such pastures for several days but this is not always practical.

Neither liver flukes nor other parasites are a concern of the sheep man whose sheep are on the forest ranges; but even with freedom from parasites and adequate pasturage at low cost, the sheep man of the mountainous country still has his problems. Poisonous plants take a tremendous toll of his flock. Predatory animals are another source of loss, and occasional serious outbreaks of black leg, hemorrhagic septicemia and foot rot contribute their share to his troubles.

Tapeworms in Dogs

By H. J. MILKS, Ithaca, New York

TAPEWORMS are very common intestinal parasites of dogs. So common in fact, that a dog stands a much greater chance of being infested with them than not. They are often present in such large numbers that the finding of a single head is no criterion by which to judge the effectiveness of treatment for them. Frequently from 5 to 20 heads may be counted after treatment and there is no possible way to determine whether or not all have been removed.

The life cycle of tapeworms is interesting. All these worms require an intermediate host. The posterior segments of the worm are the largest; the head end is the small end of the worm. As the segments develop and become mature, they are termed ripe. They are then cast off and may be seen in the feces. These segments are literally filled with eggs. When the eggs are freed from the segment, they are picked up by the proper host or susceptible animal, hatch, and then form embryos. The embryo wanders about in the host and encysts itself in different parts of its body, gaining access to the body of the animal which harbors the adult worm when the part containing the encysted embryo is eaten. It matures as a tapeworm, grows to a varying length, according to species, and in turn casts off segments.

A knowledge of the life cycle is important in the control of the worms because there is little use in ridding an animal of them and then starting him on the way toward another batch.

There are several tapeworms which occur in dogs. The following table gives their names, common synonyms and intermediate hosts.

Name	*Synonym*	*Intermediate Host*
1. Dipylidium caninum	Taenia cucumerina	Louse and flea.
2. Dipylidium sexacoronatum		
3. Taenia hydatigena	Taenia marginata	Peritoneum of ruminants and hogs.
4. Taenia pisiformis	Taenia serrata	Mesentery of rabbits.
5. Multiceps multiceps	Taenia Coenurus	Coenurus cerebralis of sheep.
6. Multiceps serialis	Taenia serialis	Connective tissue of rabbits and rodents.
7. Echinococcus granulosa	Taenia echinococcus	Internal organs of ruminants and hogs.

Since the *Dipylidium caninum* passes its encysted form in the louse and flea, it is not surprising that it is a common worm of the dog and difficult to control. The other worms are distributed among animals used for different purposes and according to their food. Dogs having access to butchers' offal are likely to be infested with Echinococcus, Hydatigena and *Multiceps multiceps;* hunting dogs (hounds) with Pisiformis, and *Multiceps serialis;* Shepherd dogs with *Multiceps multiceps.* The last mentioned parasite, or as it was formerly called, *Taenia coenurus,* is not a common parasite in this country but has been reported occasionally.

Symptoms of Tapeworm Infestation

The symptoms of tapeworm infestation in dogs are not usually marked although there has been a tendency to attribute quite positive and pronounced symptoms to them, such as enormous appetite with emaciation, nervous symptoms resembling rabies, epileptiform convulsions and other forms of nervousness. Most adult dogs harbor tapeworms with apparently no reaction or symptoms other than the passage of segments of the worms in the feces and loss of flesh when the worms are present in large numbers. Occasionally, large numbers of the worms have been found at autopsy in which there was an enteritis and no other cause of death evident. Some of these animals autopsied have been in poor condition and showed some enteritis. We have never observed any symptoms resembling rabies. There is no

question but that tapeworms are sometimes the cause of convulsions and fright disease. They are, in these conditions, just another thing to look for and clear up.

The segments are often observed upon the feces or hanging to the hair around the anus. In other instances the owners become both scared and disgusted because the segments are shed while the dog is about the house. The segments are very motile when first shed and are often referred to as "pin worms."

Diagnosis

Tapeworms are ordinarily diagnosed by the owner or someone seeing the segments in the stools. A differential diagnosis is not necessary. The ova of tapeworms are not usually found in the feces. With the exception of Dipylidium, segments usually do not disintegrate and liberate the eggs until passed. Most of the Dipylidium eggs also are passed in the segments. The differentiation of the ova of tapeworms is not easy. The ova of Dipylidium have a fairly thin shell and are usually found in clusters of from 12 to 20 within a thin membrane. The ova of the other tapeworms are ovoid or spherical and have comparatively smooth thick shells, showing radial striations. Upon close observation, six small hooks may be found embedded in the protoplasm near the center of the egg.

Treatment

This is not so simple as might be expected. There is no treatment 100% effective and every remedy has its drawbacks. Several agents are commonly recommended, including aspidium, kamala, pomegranate root bark, arecolin, areca nut and cusso. They are all useful but many disappointments follow the use of any of them. At times, one agent or combination works well and then suddenly ceases. Why? We do not know.

The animals undergoing treatment for tapeworms should be fasted at least over night, if the treatment is to be given in the morning. A purgative administered the previous evening is often useful. It is well, also, to anesthetize the stomach 20 to 30 minutes before administering the vermicides.

Oleoresin (extract) of aspidium (male fern) is usually given first place as a taenicide. It is a nasty preparation and even when administered in sealed capsules may make the dog sick unless the stomach is previously anesthetized. The recommended dose is from 15 to 90 grains (one—six gm.) administered in a capsule. Aspidium is not a laxative and it is therefore necessary to follow it with one. The oils are stated to be poor laxatives to follow aspidium because it is claimed that they increase its absorption and toxicity. Aspidium is often combined with areca nut or kamala both of which are taenicide and purgative.

Areca nut has been highly recommended by many clinicians but varies greatly in value. The freshly grated or ground nut should be used. The usual dose is two grains per pound of animal.

Arecolin hydrobromid, the chief alkaloid of areca nut, is administered *per os* in doses of 1/12—½ grain. The results from the use of this agent are often almost miraculous but, unfortunately, at other times no worms are passed. We have often failed with it and gotten the worms by other means and sometimes succeeded with it after other treatment had failed. It is not easy to explain the failures. It seems reasonable, to believe that the drug is not always up to the standard.

A fairly consistent combination or treatment is as follows: Fast over night, then give to an average collie, 30 grains of oleoresin of aspidium in a capsule, and follow in about 20 minutes with 30 grains of areca nut in a capsule. Kamala may be substituted for the areca nut.

We believe it a good plan to explain the life cycle of the worms to our clients in order to avoid disappointments, when segments are again noticed in the feces. In some animals, with Dipylidium infestation, we have found that a good cathartic administered as often as the segments are passed in large numbers or have crawled out upon the bed or pillows, will prove more serviceable and less disappointing to the owner than a taenicide.

Follicular Mange of Dogs

By W. J. LENTZ, Philadelphia, Pennsylvania
Director, Small Animal Clinic, University of Pennsylvania

FOLLICULAR mange, also known as demodectic mange, acarus mange, and red mange, is an intractable skin disease caused by an acarus mite, the *Demodex folliculorum*. Although all breeds of dogs are affected, it is more common in the short haired ones. It is essentially a disease of the young animal, occurring at a period when the pilosebaceous system is in an active stage of development. The disease is not very contagious. It is frequently associated with some non-parasitic skin affection, or intestinal parasitism, or some systemic disease (distempter, rickets, gastro-intestinal catarrh, etc.), or found in those animals in which there exists a faulty glandular activity of the digestive organs, or in those which have been improperly fed, or fed on food too carbonaceous or on food in which an essential food factor is lacking, that is to say in dogs in which for any cause the vitality of the skin has been lowered. Clinical evidence undoubtedly points to the possibility of an inherited pre-disposition at times.

Cause

A hair follicle mite, the *Demodex folliculorum*. The adult parasites, about 0.3 mm. in length, are found in the sebaceous glands and hair follicles. They have an elongated vermiform shape and are provided with eight short legs attached to the anterior third of the body. The abdomen is transversely striated and serrated along the sides and gradually tapers to a blunt point. The horse-shoe shaped head is provided with a wide and salient movable rostrum, with an upper and lower jaw and three articulated tentacles. The male is smaller than the female. The eggs are fusiform-shaped with a thin shell. The larvae are almost fully developed when hatched with the chief exception that they at first have only three pairs of limbs. The number of parasites contained in a pustule varies greatly from 20 to as high as 200. The head end of the parasite is almost always directed inward, with the larvae and eggs alongside the body.

Symptoms

Although the disease is characterized by great variations in its manifestations, two principal forms are usually recognized, the squamous form, so called, and the pustular form, the first often merging into the second.

The squamous type manifests itself in various-sized dry eczematous areas in the region of the eyes, face, elbows, hocks, toes, under-surface of the neck, and sometimes in other parts of the body as well. Such areas become denuded of hair and are covered with bran-like scales. The patches at first show but slight inflammatory changes; they soon become reddened, however, and later take on a bluish gray color. There is little if any itching as a rule. The condition may persist unchanged for months and without any impairment whatsoever of the health of the animal.

The pustular form of the disease appears most frequently on the head, neck, and legs (which often become very much swollen), spreads gradually and finally becomes generalized. The condition first manifests itself in redness, desquamation, depilitation and formation of acne pimples or papules in the affected areas. The papules soon become pustules and a sero-sanquinolent fluid, or reddish pus, may be squeezed from them in which the parasites may be found in great numbers. In course of time the manifestations become more obvious and the affected areas assume a dull reddish or purplish hue. The skin becomes thickened and rugose, and the gaping follicular orifices more sieve-like, and numerous acne and furunculosis-like lesions crop up to further complicate the clinical picture. The disease has a fetid characteristic odor, as a rule the itching is slight or entirely absent. However, one finds cases in which the pruritis

is marked. The progress of the disease is usually slow and affects the general condition and health of the animal.

Diagnosis

Follicular mange may co-exist with the ordinary skin affections of youth, with sarcoptic mange or with ring-worm. It should be remembered that it is a disease of the young animal. A positive diagnosis can be made only by finding the parasite microscopically. A papule or pustule may be squeezed and the parasites thus procured. In the squamous form it will be found necessary to grasp a fold of the skin between the index finger and thumb, exert pressure and scrape deeply with a knife. The squamous form is frequently confounded with erythema of young dogs which is non-parasitic, and instead of commencing like follicular mange on the face, neck, and paws, it commences on the inner side of the thighs, in the axilla, on the belly, and in other parts where the skin is thin and the hair fine and short.

Pathology

In the majority of instances more or less inflammation of the skin, usually subacute or chronic in character is present. The lesions are usually papular at first. Later pustulation occurs and finally desiccation, depilitation and more or less crusting, with wrinkling of the skin. The skin becomes indurated and thickened, and the presence of the mites in the hair follicles and sebaceous glands frequently causes a purulent inflammation of the peri-follicular and periglandular tissue. A concomitant seborrhoea in which the skin appears relaxed, dark and greasy is sometimes seen. A microbacillus grows very frequently in the excessive sebaceous secretion and enters the neck of the patulus follicle. The suppuration is due to the ordinary pyogenic staphylococcus which may be cultivated from the pus. I believe the bacillus is highly toxic, bringing about constitutional symptoms.

Treatment

Follicular mange is a rebellious and obstinate disorder, prone to relapses and recurrences. Perseverence in treatment is sometimes followed by a permanent cure in the course of from 3 to 8 months. Sometimes, even if untreated, the malady may disappear spontaneously. Almost every known parasiticide substance has been tried, but usually without result, as the parasites are so deeply situated, therefore, inasmuch as they are irritants they seem contraindicated because they add to the already existing inflammation of the skin. The skin should be kept as free as possible from irritation by the use of soothing ointments or emollients. We have found the following particularly useful:

℞	Phenol	20 min.
	Calamine	2 drams
	Balsam of Peru	4 drams
	Zinc Oxide Ointment	1 ounce
℞	Sulphur	4 drams
	Potassium Carbonate	1 dram
	Lard	1 ounce
℞	Oil of Cade	1 dram
	Oil of Chaulmoogra	1 dram
	Alcohol	1 ounce
	Glycerine q.s. a.d.	2 ounces
℞	Icthyol Ointment	25 per cent

Such preparations must be applied daily, but to only one-third of the body at a time. An olive oil and cocoanut oil shampoo every two to three weeks is indicated. The raw yolks of several eggs rubbed on the affected parts facilitates the washing off of the oil. Irritant soaps are to be avoided. Vaccine therapy has been employed. In the majority of instances the results have been disappointing. Stock vaccine is of no value. Autogenous preparations of the staphylococcus pyogenes from three to five million organism doses to be repeated at intervals of from three to five days, the amount being gradually increased, are sometimes beneficial. Repeated exposure to ultra-violet light or large incandescent lamps (500 C.P.) is a valuable adjuvant when carried out with the preceding treatment. A nutritious diet, suited to the carniverous digestion, systemic tonics, correction of any associated malady are factors requiring the clinicians most rigid attention if a cure is to be expected.

Hookworm Disease of Dogs and Cats

By J. G. HORNING, and A. J. McKEE, Houston, Texas

THE term hookworm may be applied to all members of the Ancylostomidae family. The species veterinarians have to contend with in dogs and cats are *Ancylostoma braziliense* and *Ancylostoma caninum*. The geographical location of the animals is a factor in the type of worm with which they are infected; *A. braziliense* being the predominating species in cats examined in the tropics, tropical America and southern United States. In more northern localities both in America and Europe, *A. braziliense* gives way entirely to *A. caninum* in cats, and in Europe both species are largely replaced in dogs by *Uncinaria stenocephala*, a species belonging to the same sub-family as Nector. In dogs *A. Braziliense* is also common throughout the tropics, but does not replace *A. caninum* so completely as it does in cats.

Method of Infestation

Looss doing some work in 1903 with larvae infested material became convinced that infection by way of the skin was the usual mode of entrance and was able to prove this by experiments on dogs. Chandler also claims that this is the usual entrance in dogs and cats as well as men.

The animal comes in contact with infected ground, the larvae immediately attach themselves to the hair or skin, and, by an active swimming movement, enter the natural fissures and pores of the skin. Gaining sufficient leverage, they penetrate through the epidermis and the dermis, in some cases penetrating the dermis in 35 to 40 minutes, and finally enter the subcutaneous tissues, find their way to the superficial lymphatic capillaries of the dermis, (a small number enter the blood capillaries) and migrate through the blood and lymph streams to reach the lungs and other body organs.

The minimum time required to reach the mucosa of the trachea appears to be two to three days, but the majority do not finish their round-about migration through the body in less than four or five days and some take still longer. They are then coughed up and in most cases swallowed and develop in the alimentary canal.

Yokogawa (1926) demonstrated that when larvae of *A. caninum* are given *per os* to their proper host, the dog, few penetrate the walls of the alimentary canal and enter the circulation but nearly all develop directly in the alimentary canal without migration. According to Herrick (1928), after infection *per os*, eggs appear in the feces of pups in from 15 to 18 days, of young dogs in 15 to 20 days, and of old dogs in 15 to 26 days. The peak of production is reached in from 25 to 41 days, averaging about 28 days in pups and 39 days in old dogs. Sarles (1928) found that egg production gradually fell off after the peak was reached, undoubtedly due to gradual loss of worms, until the dogs became negative to egg counts in from 44 to 83 weeks, this, of course, in cases where reinfestation was stopped.

From our own observations we believe that infection by mouth is as great as through the skin in the territory where we practice, which has a sub-tropical climate. Numerous demonstrations to establish the fact that there is a resistance to worms in the gut after an invasion, have been carried out by Herrick, Sarles and Sandground, but in our opinion this requires further work. They have demonstrated that age is a factor, as the more mature the animal the more difficult it is to infect. Race has to be taken into consideration as cats are more resistant to *A. caninum* than dogs.

Symptoms

The symptoms vary according to the severity of the infection. Young pups that have had a prenatal infection show extreme dullness, in some cases gastric pain, bloat

rapidly after nursing, and, on examination, show a decided anemia. When the pups are large enough to crawl and their eyes are open they will eat dirt, and the older they grow the greater tendency they will have to being pot bellied, to show an unthrifty coat, anemic membranes, and precarious appetite. In some cases they show pustules and skin rash, and develop convulsions. The best plan when making a physical examination is to make also a fecal examination for intestinal parasites.

Treatment

We usually start treatment as soon as the animal is large enough to swallow a 0.2cc capsule of tetrachlorethylene, which is usually at the age of about two weeks in the larger breeds and three weeks in the toy breeds. The pup is kept away from the mother for four hours, the capsule administered, and this followed in one hour with one teaspoonful of castor oil for toy and two teaspoonfuls to the larger sized pups. It is kept away until it has a good bowel action and then returned to its mother and allowed to nurse. Treatment is repeated in two weeks according to the weight of the patient. In treating the older dogs we use tetrachlorethylene and dose according to weight, however the dogs are given a liquid meal, preferably milk, the night before, and the following morning on an empty stomach are given the medicine. No water or food is given and in one hour a suitable dose of castor oil is given, depending upon the size of the dog. After the dog has a bowel action it may be fed warm milk or meat broth that has no fat in it.

Tail of Male Hookworm. Low Magnification.

We never give more than four 1cc capsules of tetrachlorethylene to the largest dogs we treat, and the results are always satisfactory. Those cases that get drunk on the medicine are usually the ones that are constipated at the time medicine is administered, and in our practice are the ones that are treated by the owner at home. Seeing that the dog is cleaned out before starting treatment and restricted to the milk meal the night before, avoids this trouble.

WHIPWORM DISEASE OF DOGS

From investigation of the work of others and from our own observation we have come to the conclusion that the seriousness of whipworm disease in dogs is greatly overrated. The infestation is not nearly as heavy as it is usually suspected of being, and all parasitologists agree that the whipworm of the dog, *Trichuris vulpis,* is nonpathogenic for that animal. In man whipworms occasionally produce a cecitis and in some cases it has been claimed, appendicitis.

Practically all anthelmintics fail in the treatment of whipworm infestation. The best results, such as they are, are obtained from the administration of the latex of *Fiscus laurifolia* recommended by Berrio (1912) and Mont-Biggs (1915). The use of this agent in man was satisfactory, but in dogs it had little value.

More recently (November, 1929) the *Journal of Tropical Medicine* contained an article on the use of an active principle of the latex of *F. laurifolia,* higuerolatex, that promises great possibilities. However the small, if any, amount of trouble caused by this parasite in dogs probably does not justify any considerable experimental work along these lines.

Houston, Tex. J. G. Horning.
A. J. McKee.

Round Worms in Dogs

By HADLEY STEPHENSON, Ithaca, New York

THE presence of round worms in dogs is such a common condition and its diagnosis and treatment so well understood by the profession that it hardly seems necessary to add further comment on the condition. But sometimes the common everyday thing is so close to us and so obvious that we loose sight of the details. For this reason it is well to review our knowledge of the condition occasionally.

Prevalence

The prevalence of round worms in dogs was found by Dederick, in Ithaca, to be 23.33 per cent, and by Hall, in Detroit, to be 46 per cent. These figures were for the general run of dogs of all ages. If only puppies had been examined the percentages would have been much higher, possibly ninety or above. There are very few dogs but what have had round worms sometime during their lives. The older dogs seem to develop an immunity to round worms. Those few that are infested are not so seriously affected as are the puppies.

Varieties

Round worms of dogs are of two varieties, *Toxascaris limbata* and *Belascaris marginata*. The two are not easily differentiated except by their eggs. As far as treatment goes it is not necessary to distinguish between the two. Some veterinarians consider that the Toxascaris affect the dog more severely than the Belascaris. The life history of these worms has not been worked out, although it is thought to be similar to that of *Ascaris lumbrocoides*, the round worm of the pig. As the life history of the latter may be of some value in our consideration of the round worms of dogs it will be briefly given.

Life History of Ascaris

Ransom and Foster found that the embryos of *A. lumbricoides* develop in ten days at 91 deg. F., with a slower development if the temperature is lower or if oxygen or moisture is absent. After ingestion the embryos escape from the eggs in the small intestine and within two days have been found in the liver, within three days in the lungs and trachea, and within six days back in the intestines again, ready to develop to maturity. Hadley, Warwick and Gildow were able to demonstrate the presence of ascarid embryos in the lungs of unborn foxes.

Identification of Eggs

The eggs of the Belascaris are round, thick shelled, with a rough or crenated surface and slightly yellowish in color. They are about eight microns in diameter. If the microscopic field under the low power is taken to appear about the size of the face of the ordinary watch, then the eggs will appear to be about half the diameter of the space occupied by the second hand. The cell completely fills the shell.

The eggs of the Toxascaris are slightly smaller, oval, with a thicker but clear shell, and with a smooth surface. The cell does not completely fill the shell.

Both varieties of round worms appear alike. They may be from two to eight inches long. On the anterior ends are two wing like projections, making the end appear like a lance. The bodies are round and slender. When passed they may be found curled up, making a circle from one to three inches in diameter.

Symptoms

The symptoms of round-worm infestation in dogs are really few. Poor appetite, abdominal pain, vomiting and pot-belly in pups are indicative of digestive disturbance probably caused by the presence of round worms. Respiratory troubles in very young pups may also result from the presence of the embryos in the lungs. The true symptom is finding the worm either in the vomiting or in the stool.

Space does not permit of a discussion of the toxemia that may be caused by these

worms or the fits induced because of their irritation or of other effects upon the host.

Diagnosis depends on finding the worm or the eggs. A microscopic examination of the feces should be a routaine procedure whenever round worms, or any other kind of intestinal worms, are suspected. The owner's reasons for having his pup wormed are so many and so varied that it becomes important for us, from a professional standpoint, to actually demonstrate to him the presence or absence of worms as determined by the microscopic examination. An expensive microscope is not necessary, only the low power being used.

Examination of Feces

A small amount of feces, enough to cover the point of a knife, may be smeared on a glass slide and moistened with a drop or two of water or 10 per cent sodium hydroxide solution, and then examined under the low power. The only precaution necessary is to get the smear thin enough to be seen through and to use as little light as possible so that the eggs will show more distinctly.

Another method of preparation of the feces brings about a concentration of the eggs so that they may be discovered even if only a few are being passed. A teaspoonful of feces are mixed with three or four teaspoons full of water. This is strained through any fine strainer, such as a fine tea strainer obtained at any five-and-ten-cent store. A test tube is filled from one-third to one-half full with the suspension that has passed through the strainer. The test tube is then filled with glycerin or concentrated sugar solution and shaken. Within eight or twelve hours the round worm eggs will have risen to the top. Then a glass rod may be touched to the surface and a drop transferred to a glass slide and examined under the microscope. If time does not permit waiting for the eggs to rise, the test tube may be centrifuged and the eggs brought to the top of the tube in five minutes. If this is done the test tubes used should be heavy enough to stand the strain of centrifuging.

Treatment

In the treatment of dogs suffering from round worms our first aim is to remove the worms. Next our aim is to restore the vitality of the dog. The agents used in treatment should have a selective action in that they harm the worm but do not harm the host. We are still searching for the anthelmintic that will do this. Nevertheless we have a few anthelmentics that are particularly useful against round worms, as chenopodium, santonin, carbon tetrachlorid, and tetrachlorethylene.

Fasting of the dog previous to administration of the drugs is done to reduce the intestinal contents so that the remedies will come in closer contact with the worms. As anthelmintics rarely kill worms but only stufefy them, cathartics are usually given at the same time to sweep the parasites out of the intestine. The dose of the different anthelmintics is usually based upon the weight of the dog to be treated. This is a good method but does not necessarily hold true at all times. We are really treating a worm, or attempting to poison a worm, and then have it removed by active purgation. It is well to know how much of a drug a dog will stand without being poisoned, but, on the other hand, we should use no more than is necessary to affect the worms. In other words our treatment should be directed against worms rather than against dogs that have worms.

The dose of oil of chenopodium ranges from 3 minims (0.2cc) for small toys and pups to 20 minims (1.3cc) for large adult dogs. This should be accompanied by a generous dose of castor oil. Hall and Wigdor found that large doses of castor oil saved dogs from what ordinarily would have been lethal doses of oil of chenopodium.

The following prescription (modified from Hoare) is good, and, in our hands, has never been followed by intestinal irritation or poisoning:

℞

Olei Chenopodii ..... ℥j
Olei Terebinthinae ..... ℥ss
Spiritus Etheris Nitrosi. ℥J
Olei Ricini ..... ℥iij

Misce.

Sig. For puppies up to six weeks of age give one teaspoonful, from six to eight weeks give two teaspoonful, and from eight to twelve weeks give three teaspoonsful. One to two teaspoonsful additional of castor oil may be given at the same time. If catharsis does not take place in four hours give more castor oil.

This prescription will figure out about 2.2 minims of oil of chenopodium per dram so that it can be seen that the doses are not excessive.

The dose of santonin ranges from 1/10th grain to three grains, depending upon size and age. It is usually obtainable in pills containing an equal amount of calomel. Castor oil may also be used as a purgative with santonin. One-fifth grain each of calomel and santonin administered every hour until catharsis starts is an effective method for ridding young pups of round worms.

Carbon tetrachlorid and tetrachlorethylene are both considered as efficient against round worms. Sometimes the results seem miraculous, great numbers of round worms being passed, even without the use of cathartics. At other times very few worms or none are passed even if the microscopic examination revealed a large number of eggs. Both drugs are considered safe, the latter especially so because of less liability of suffocation or asphyxia if accidentally inhaled, and since it is not absorbed as readily as is carbon tetrachlorid it is less prone to cause injury to the liver.

Occasional cases will be encountered that require heroic treatment. We have had a few dogs from which the worms were not removed by what were considered as safe doses of anthelmintic. These required the administration of relatively large doses of anthelmintic and also of cathartic. One or two drops of croton oil added to the castor oil in such cases may prove effective. Also from one-quarter to one-half dram of freshly grated areca nut or one-quarter grain of arecolin *per os* may be necessary to bring about removal of the worms stupefied by the anthelmintic.

The discovery of prenatal infestation in foxes may throw some light on the very early development of mature worms in puppies. They may have already become infested in embryo. Thus the practice of treating brood bitches to keep them free of round worms has much to commend it. It is possibly the only effective measure that we can use to keep down the possibility of infestation in young puppies.

The overdosing of young dogs with proprietary remedies to rid them of round worms does nearly as much harm as do the worms. One duty we owe our clients is to impress upon them constantly that all efficient anthelmintics are poisons, that their administration should always be under the direction of professional men and that every time a dog bats an eyelash he is not necessarily suffering from worms.

THE 11TH INTERNATIONAL VETERINARY CONGRESS

The International Veterinary Congress, which will convene in London, England, August 4th to 9th, will be the eleventh such convention. The tenth Congress, opened in London, August 3rd, 1914, and was closed the following day, because of the outbreak of the World War, without a single paper having been read.

About 40 American veterinarians and their wives were in London to attend the last Congress. More than twice that number will attend the Congress this year. Unfortunately, the dates of the International Congress and the meeting of the A. V. M. A. come so near together that one can attend both meetings only by leaving London immediately after the close of the Congress and traveling continuously to Los Angeles. Had the meetings been set a month apart, the attendance at each would have been greater. As it is, but two or three have indicated their intention of attending both meetings, which are held approximately equi-distant from New York City.

Parasites of Foxes

By B. ERRINGTON, Ithaca, New York

IN THE control of internal parasites of foxes the major problem is that of minimizing reinfestation. Anthelmintics must be used regularly on most ranches, but they need not be used frequently if the time of administration is wisely chosen and proper sanitary and preventative measures are practiced throughout the year.

There are certain periods in the year when outbreaks of the different parasitic diseases occur. Foxes should not be promiscuously dosed for worms, but the rancher may very advantageously treat these diseases at the beginning of the seasonal occurrence. The foxes which are heavily infested should be promptly dosed and measures instituted which will eliminate a prompt reinfestation.

Undoubtedly some ranches have been able to operate over long periods without using anthelmintics. They have been able to break into the life cycle of the parasites with sanitation. The most practical way of doing this with the common internal parasites is to prevent the contact of the foxes with their feces; by removal of the feces from the yards. If the soil is sandy, a thorough job can be done. In heavy infestations, it may be necessary to break into this life cycle by placing the foxes on board or elevated wire floors.

At each thaw during the winter, the droppings should be picked up and disposed of at a safe distance from the ranch. When the spring thaws begin the object should be to remove all of the feces while they are still on the snow and thus prevent further contamination of the soil. The dens should be thoroughly cleaned at this time.

During the warm summer months, the droppings should be picked up daily. Sanitation in watering and feeding should be practiced.

One of the advantages of recording the matings is that it allows one to safely prepare a clean den and nest box for the whelping vixen. Worm eggs which are in the feces in the nest box or on the teats of the vixen may be ingested by the pups soon after they are born.

Only the common parasites will be mentioned here, and little will be said about fleas except that it must be remembered that spraying the dens is just as important as spraying or dusting the foxes.

Roundworms

Both *Belascaris marginata* and *Toxascaris limbata* are found in foxes, but the former is more common. As would be expected, the roundworm is a menace to pups rather than to adults. It is interesting to note that in some years practically all of the pups on a ranch are quite heavily infested, while in other years the infestation is comparatively light.

In heavily infested pups, the whole litter may be unthrifty, and there may be a noticeable difference in size among pups in the same litter. Other symptoms, as anemia, restlessness, potbelly, irregular appetite and convulsions are seen. Disease is indicated by the fur being thin and light colored, with little guard hair, or by its having a brownish tinge.

Roundworm treatment of the older pups is usually necessary before all of the pups on the ranch are whelped. Pups do not come out of the dens of their own accord until they are four weeks old, but they are usually able to get back into their dens after they are three weeks old. We attempt to clean the den and nest box a few days before the litter is born and then do not open the den until the litter is three weeks old. Inasmuch as we believe it is impractical to make microscopic examination of the feces of young pups, we begin by treating all of the pups at the age of three to four weeks, and depend upon the result of this treatment to decide the advisability of treating the rest of the pups when they reach this age.

The pups to be treated are taken away from the vixen before the morning feed,

treated about 11:00 o'clock, and returned to the vixen about 1:00 o'clock. It is advisable to treat pups only on fair, warm days, as there is always the danger of the vixen carrying her pups out of the den after they are returned to her. In treating for roundworms, we use oil of chenopodium and castor oil, one part to twenty-one parts, giving one c. c. to each pound of fox. To administer it, we use a graduated syringe with an attached rubber tube, which is passed into the esophagus. One treatment for roundworms will usually tide the pups over till the hookworm period.

Hookworms

The hookworm, *Uncinaria stenocephala,* is a common parasite in adults as well as in pups over ten weeks of age. It necessi-

tates a constant observation of the foxes, especially during July and August, to keep down the losses. Pups from three to six months of age are most susceptible. Although the seasonal occurrence of this disease is during the summer and fall, there have been cases of entire ranches being infested in the middle of winter. Undoubtedly this was due to neglect in the care of the foxes, and to their coming into the breeding season in poor condition with a heavy infestation from the preceding fall.

After pups are ten weeks of age, it is advisable to make microscopic examination of the feces of all pups, at intervals of three or four weeks, if the previous examination was negative. Fecal examination is immediately made of any fox showing symptoms resembling hookworm disease during the summer. All moderate and heavy infestations are treated with tetrachlorethylene, which is quite a safe and efficient anthelmintic. If we find at the pelting season that a majority of the foxes is suffering from hookworms, we treat all of the breeding stock.

However, it has been our experience that one treatment in the early summer is all that is necessary, if proper sanitation or preventive measures can be carried out. Heavy infestations are not common in adult stock on efficiently operated ranches.

Lungworms

Lungworm infestation is on the increase in ranch-raised foxes and is now a serious problem on many ranches. The two species found in foxes are *Capillaria aerophila* and *Crenosoma semiarmatum.* The disease produced by them is of a chronic and insidious nature, and unless a rancher makes a microscopic examination of the feces of his foxes, lungworms are often present on his ranch long before he suspects them. Men who have been making fecal examination of dogs should remember that the egg of the whipworm is very similar to the egg of the lungworm of foxes. The lungworm egg is only a few microns longer.

The symptoms which are prominent in heavy or moderate infestations, especially when a fox is forced to exert itself, are: short wind, wheezy breathing, and a hacking cough. Dyspnea is common. Emaciation, anemia, weakness, and a dry, lusterless coat are manifest in the later stages, and pneumonia is often a part of the picture. The parasite may be easily overlooked on postmortem examination. They vary from one to two and a half inches in length, are about the diameter of a coarse hair, and are similar in color to the lining membrane of the trachea.

Reinfestation is lessened during the fall and winter months and foxes with a light or moderate infestation tend to recover from the symptoms and the infestation. Lungworms of foxes differ from lungworms of some of the domestic animals in that they tend to work up into the trachea from the air passages in the lungs. Mechanically removing them from the trachea with a brush has proved a very successful treatment when the infestation is moderate and reinfestation is controlled. Reinfestation can be controlled

by placing the foxes on elevated wire floors.

Regarding this treatment and control, Dr. Hanson of the United States Fur Experiment station has said: "When foxes with lungworm trouble are taken in time, that is, providing the infestation is not too heavy and not complicated by serious bacterial infection, they usually can be cured in the course of eight to twelve weeks by keeping them on elevated wire floors and treating them at bi-weekly intervals with a tracheal brush."

Ear Mange

Ear Mange is caused by the mite known as *Otodectes cynotis,* which produces an inflammation inside the ear flap and auricular canal. This parasite is easily eradicated. A great number of ranches are free from it. However, it spreads rapidly, and where it is present large numbers of foxes are usually affected.

Some of the symptoms commonly observed are scratching the ears, shaking the head, carrying the head twisted with one ear down, travelling in circles, and convulsions. If the ear is examined, grayish crusts may be found, or in more chronic cases a profuse, dark-colored waxy material. There may be a foul smelling exudate. Fluid in the canal can be diagnosed by palpation.

By picking some of the grayish crusts or waxy material out of the ear and placing it on a dark background, the light colored mites may be seen moving. They are just visible with the naked eye.

Many remedies are used in treating for ear mange, and most of them are probably successful. A mild disinfectant in oil is needed. Either 2% lysol or phenol in cotton-seed oil serves very well. Clean the ear with dry cotton, then pour the solution in the ear canal, and gently massage the base of the ear until the solution has had time to work into the canal and the affected part of the ear flap is covered. The treatment should be repeated in ten to twelve days.

The mite can be eradicated by treating all of the foxes on the ranch in this manner. All foxes brought into the ranch should be examined for ear mites.

COW'S CONTRIBUTION TO CIVILIZATION

Among the many interesting exhibits which will be shown to the A. V. M. A. Convention visitors at the headquarters in Los Angeles is one well-named, "The Cow's Contribution to Civilization."

This educational exhibit, kindly loaned from the collection of the Ideal Certified Dairy, is not only a vivid record of the cow's contribution to the civilization of past ages, but it also contains an astounding array of products which enter into the everyday life of modern man.

Many of us who have habitually looked upon the cow as merely a producer of milk, butter, cheese, meat and professional calls, will be surprised to learn the vital part she plays in the production of a host of objects of everyday use.

A well known Moscow (Idaho) veterinarian, examining a common Idaho product. As the Doctor is above the average in stature and the wheat by no means an uncommon sample, one reason for the surplus of this product that worries the Federal Farm Board is evident.

Salmon Poisoning in Dogs and Foxes

By B. T. SIMMS, Corvallis, Oregon

THE fluke *Nanophyetus salmincola* Chapin, which causes salmon poisoning, is apparently limited in its distribution to northwestern California, western Oregon, and southwestern Washington. Raccoons, bobcats and probably other wild fish-eating carnivores are hosts of the parasite, but it is in the dog family only that it causes the disease known as salmon poisoning.

Life Cycle

The life history of this fluke is as follows: Eggs passed out in the feces of infested animals hatch in 50 to 80 days. The miracidia emerging from the eggs attack the fresh water snail *Goniobasis plicifera var silicula* Gould. Cercariae leave the infested snails and attack either trout or salmon. They become encysted in nearly every part of the fish's body, being especially numerous in the kidneys and in some of the muscles.

Symptoms

When infested fish are eaten by a susceptible dog symptoms develop about the seventh day. They consist of loss of appetite, elevation of temperature (104° to 106° F.), rapid pulse, increased thirst, rapid loss of weight, and extreme lassitude. There is frequently a purulent discharge from the eyes and sometimes an edema of the tissues around these organs making them appear sunken. After the second or third day the temperature usually goes down, dropping from a half to a degree each day. Very persistent vomiting may appear about the third to fifth day. The thirst is markedly increased at this time and the animal drinks only to vomit within a few minutes. The bowels are frequently costive at the beginning but usually a bloody diarrhea sets in about the fourth or fifth day. The temperature, dropping a little each day, is back to normal about the fifth or sixth day after symptoms appear. At this time the animal appears brighter and may even take a small amount of food, but in most instances the temperature continues to go down, reaching subnormal about the sixth or seventh day, and death occurs about the seventh day. Mortality has been above 90 per cent in experimental cases.

Lesions

The principal autopsy finding is a severe hemorrhagic enteritis attacking the entire intestine but worse in the duodenum and the rectum than in other regions. The cecal lymph gland is usually very considerably enlarged. The flukes are in most instances present in large numbers in the intestines, but since they are only about 1/50 of an inch long they are easily overlooked unless a microscopic examination is made. Microscopic sections reveal flukes buried in the mucosa of the duodenum but not in that of any other portion of the intestine.

Diagnosis

Definite diagnosis can be made by finding eggs of the flukes in the feces. These eggs are oval in shape, and about 75 microns long. They appear in the feces on the fifth to seventh day after the fish is eaten, or about the time the symptoms are first noticed.

Treatment

So far all attempts at treatment after symptoms appear have been unsuccessful. Emetics given within a few hours after the fish was eaten and before it had passed out of the stomach have prevented the appearance of the disease.

Dogs which recover are immune for life. No other method of producing the immunity than by an attack of the disease has been found.

Prevention

The only satisfactory control measures known at present consist of preventing all susceptible dogs from eating any raw salmon or trout which has originated in any of the streams of the salmon poisoning district.

Recent Developments in the Importance and Control of the Intestinal Roundworm of Chickens

By JAMES E. ACKERT, Ph.D., Manhattan, Kansas
Professor of Zoology and Experiment Station Parasitologist,
Kansas State Agricultural College

THE large roundworms, *Ascaridia lineata* (Schneider), of chickens are of frequent occurrence throughout the United States and southern Canada. Examinations of several thousand chickens indicate that from 25 to 50 per cent of the chickens in certain localities are infested with this worm. The development is direct, no intermediate host being required for transmission from one chicken to another.

Life Cycle

The eggs of *Ascaridia lineata* (Schneider) after incubating in the soil for a week or more, give rise on being swallowed by chickens to larvae. In younger fowls the larvae penetrate the wall of the intestine, causing loss of blood and lymph, retarding muscular and bone development, reducing the amount of sugar in the blood and shrinking the thymus glands. After about two weeks of parasitism the young worms withdraw from the intestinal wall into the lumen where they may grow to maturity in about one to two months, depending upon the age of the chicken.

Age Immunity

Resistance to the growth of the intestinal roundworm, develops at an early age in chickens and gradually increases until the bird is 100 days old at which time it may swallow large numbers of infective eggs of the parasite without suffering from the effects of the worms. When such chickens are fed diets lacking vitamins A and B their resistance to the worms is lowered.

Prevention

Control measures against the roundworm include keeping the chickens free from these worms for 10 to 12 weeks on a diet adequate for normal growth and development. Rotation of yards facilitates keeping chickens free from the worms as its eggs on the surface of the soil are known to perish during the summer.

Another control measure is the restriction of worm egg production by the utilization of carbontetrachloride at the dosage rate of 4cc. per kilo of body weight for the removal of worms from growing and adult chickens.

Test for Infested Poultry Yards

Poultry yards may be tested for live worm eggs by the application of a new technic for isolating worm eggs from soil. A pint or more of soil is collected from a suspected spot by sweeping or slightly scraping the surface of the ground over a large area. This soil is then taken to a laboratory where it is crushed and mixed. From it a representative sample is placed in a centrifugal tube, treated with antiformin and stirred frequently to separate the dirt from the worm eggs. The tube is then filled with sodium dichromate (specific gravity .35), shaken thoroughly and centrifuged at 1,000 revolutions per minute for one or two minutes. Roundworm eggs present will be at the top of the tube from where they may be looped off with the mouth of an inverted vial to a glass slide for microscopical examination. Thus, it is now feasible to test a poultry yard for live eggs of *Ascaridia lineata* and of other nematodes before placing young chickens in them.

Coccidiosis of Fowls

By H. M. MARTIN, Lincoln, Nebraska
Department of Animal Pathology, University of Nebraska

COCCIDIOSIS is an intestinal disease of birds and is widely distributed geographically. This disease has been reported in numerous species, including chickens, ducks, geese, pheasants, peafowls, turkeys, grouse and other game birds.

Cause

The disease is caused by a protozoan parasite. The name generally designated for the causative factor of this condition is the *Eimeria avium,* but recently Johnson (2) reported the presence of no less than four different species of coccidia in the intestinal tract of chickens; two of which are definitely known to produce disease. The one causes severe infection in the small intestine, and the other is responsible for the acute coccidiosis of the ceca. These parasites undergo certain phases of their life-history in the cells of the mucous membrane of the intestine. Following this, they leave the body of the host in the feces, by which food, water and the soil with which the poultry come in contact become contaminated. In these locations outside the body of the bird the parasites reach the infective stage in from two to three days.

Symptoms

The clinical picture of this disease is not at all characteristic. As in other microbic diseases one observes a depression, ruffled feathers or down, weakness, dullness, disinclination to move about and also a loss of appetite. In young birds these symptoms may develop rapidly and lead to death.

Diarrhea is commonly observed in coccidiosis and the soft or semisolid feces are often streaked with blood.

In adult birds the disease assumes a more chronic form. They show signs of ill health of a rather indefinite nature. These animals become inactive, stupid, lose flesh and present a pallor of the comb and wattles. In some instances there is an inability to stand and a diarrhea is not uncommonly encountered.

Diagnosis

Coccidiosis may easily be confused with other intestinal diseases of poultry. A microscopic examination of the intestinal discharges or, still better, of the contents of the ceca is almost the only way that an absolute diagnosis can be established.

Lesions

In this disease a postmortem examination of affected birds is very valuable. In such animals the pathologic alterations are principally encountered in the ceca, but it is not uncommon to find lesions in the duodenum. In these portions of the digestive tract one finds an inflammation and thickening of the walls. The lesions in the blind guts are, as a rule, more extensive and acute than in other parts of the intestine. The intestine involved appears larger, is hyperemic, and hemorrhagic. In some instances, the mucous membrane may be partially or completely destroyed. The contents of the intestine are bloody and may be liquid or more or less solid, or a cheesy mass streaked with blood. The latter may be observed more often in older birds.

In some fowls the liver and lungs are involved. It manifests itself in these organs by light-colored spots or by the formation of cheesy deposits.

Course

Coccidiosis in brooder chicks is rapidly fatal; practically all of the affected ones succumb to the disease. In older fowls the mortality is lower and the disease is more chronic in form. The mortality appears to be greater in flocks kept in insanitary confinement. Many of the older birds appear to recover from the disease. Some, if not all, of the animals which seem to have recovered continue to carry these parasites and become reservoirs by which the disease

may be indefinitely maintained in a poultry yard.

Treatment and Prevention

This is a disease which does not respond to medical treatment. Many different drugs have been tried, but none of them showed promise. Krijgsman (3) tried catachu, areca nut, lactose, and several proprietary medicines, and found all of them wanting, with the possible exception of lactose (two parts of powdered lactose and three parts of mash) and the value of this he considered doubtful.

Expensive, well built chicken houses with concrete floors such as this, are out of date. The chief preventive measure both of parasites and infectious diseases of chickens, is a clean range and this is best attained with more or less temporary houses that can be either moved or abandoned temporarily.

About the only efforts which can be made against coccidiosis with any hope of success are of a preventive nature. Points of special value in the prevention of this disease is to avoid overcrowding the birds in closely confined yards. They should be provided with clean feed, and water, and in such a way as to make contamination with fecal material impossible.

The rotation of poultry yards should also receive consideration as a means of preventing the disease from doing damage. The old yards should be plowed up and put under cultivation.

In flocks already infected, the healthy birds should be removed to clean ground. The diseased birds should immediately be destroyed or kept in isolation. The grain in their ration should be reduced and milk in some form should be offered as a substitute. Johnson (1) indicated that a ration consisting of 40% milk is worthy of consideration. Feeding buttermilk and other forms of sour milk may also be of value.

Brooder houses, poultry houses and appliances for feeding and watering should be regularly cleaned with boiling lye water. The use of disinfectants is frequently recommended for the control of this disease, but it is not known to what extent the parasite of coccidiosis can be destroyed in this manner.

Another factor in the prevention of this disease is the advisability of keeping the young chicks away from yards occupied by older birds. The chicks should have access to clean premises especially reserved for them. Their runways should be graveled or cemented whenever it is possible to do so as it assists greatly in keeping the yards clean. Where there is infection in the chicks, daily cleaning of their quarters is recommended in order to eliminate the parasites before they develop to their infectious stage.

The poultry raiser must take a leaf from the successful swine breeder's book of experience and get his chicks away from older birds and contaminated surroundings, even as the swine grower by means of individual brood and sow houses, has been able to avoid 90% of his losses from filth borne diseases and parasitisms.

REFERENCES

(1) Johnson. Avian coccidiosis studies. Proc. World Poultry Congress, 1927.
(2) Johnson. Coccidiosis of the Chicken. Oregon Agr. Exp. Sta. Bul. 238, 1928.
(3) Van Heelsbergen. Handbuch der Geflügelkrankheiten und der Geflügelzucht. S. 348, 1929, Stuttgart.

Poultry Mites

THE henhouse mite, *Dermanyssus gallinae,* is a common and destructive parasite of poultry. They are small greyish colored parasites, but appear red when engorged with blood. Unlike lice they do not spend all or all of any phase of their life cycle upon their hosts. During the day they hide in cracks, crevices, under litter, droppings and other debris in the poultry house; it is in these places that they breed. At night they attack the fowls and feast upon their blood, at the same time causing much irritation. Hens while incubating eggs are attacked day and night and often to such an extent that they desert their nests. They may sometimes be seen in the day on weak fowls.

Symptoms

The principal effects of mite infestation are: anemia, emaciation, decreased production, retarded growth, and sometimes death. Small chicks when attacked suffer most.

Prevention and Treatment

Eradication is effectively carried out by strict cleanliness of houses and the application of suitable parasiticides, one part kerosene to three parts crude oil is one of the best to use. Smooth surfaced interior of houses facilitates eradication.

Incubating hens should be dusted with pyrethrum powder.

Chigger Infestation

The presence of the larva of the harvest mite (chigger, chigoe, jigger, red bug, harvest tick, etc.), *Trombidium holosericeum,* on poultry has been reported. The harvest mites inhabit wooded places, especially where there is grass and underbrush. When poultry frequent infested places the larva may imbed themselves in the fowl's skin causing a small red elevated zone in the center of which the larva can be detected as a bright red speck. Intense irritation is produced and causes decided itching. The parasitic larva die upon entering the skin. If infestation becomes troublesome fowls should be kept away from infested places during the late summer and early fall. The irritation can be allayed by the application of ammonia solutions, tincture of iodin and strong solutions of bicarbonate of soda.

Scabies of Poultry

There are two species of mange mites that infest poultry, the most common of which is the scaly leg mite, *Cnemidocoptes mutans* (*Sarcoptes mutans* var, *gallinae*). The symptoms produced are rough, irregular, crusty accumulations on the feet and legs. Practically everyone who handles chickens is familiar with the symptoms found. Kerosene oil applied to affected parts is an excellent treatment but do not allow the kerosene to come in contact with feathered portions of the fowl, for it may produce an obstinate blister if applied to these parts. Washing the feet and legs with warm, soapy water or strong bicarbonate or carbonate of soda solutions and drying thoroughly before applying the oil is beneficial, but is hardly practical except in individual cases.

The second species of mange mite infesting poultry is the depluming mite, *Cnemidocoptes gallinae.* This species is not often found but spreads rapidly after once being introduced. They are to be found at the base of the feather and in the feather follicle.

The symptoms are: loss of feathers leaving denuded areas, the fowl's plumage soon presents a very ragged unsightly appearance, birds become restless, production decreases and moderate emaciation may result. Mild ointments applied to affected areas is an effective treatment.

Prevention of both species of mange mites consists in not allowing an infested bird to be introduced into a clean flock.

Air Sac Mite

The air sac mite, *Cytoleichus nudus,* is encountered only on autopsy, in which case they may be found in the air sacs and appear as small greyish objects. Just what their presence signifies is not clearly under-

stood. They may at times cause inflammatory lesions in the invaded organs.

Connective Tissue Mite

The connective tissue mite *Laminosioptes cysticola,* is frequently encountered on autopsy. Yellow oval bodies are often found beneath the skin of the breast, thighs and neck. These bodies are said to be lesions produced by connective tissue mites. The significance of their presence is unknown. So far as our present knowledge goes they cause no appreciable harm.

Fowl Tick

The fowl tick, *Argas miniatus,* is found in the southwestern part of the United States. These ticks hide away in the day and come forth at night to feed upon the blood of their host. The larvae once attached remain so for several days or until they are ready for a new molt. Much harm is done the host through loss of blood and irritation.

The symptoms are about the same as those described for henhouse mites.

The fowl tick is said to act as a carrier for the *Spirocheta gallinarum,* an organism that produces a fatal septicemia in fowls. The method outlined for the eradication of henhouse mites should apply in regard to fowl ticks. When the tick is found attached to the host they should be carefully removed, killed and a suitable antiseptic applied to the wound.

Poultry Lice

By F. D. PATTERSON, Jr., Ames, Iowa

LICE are one of the most common poultry parasites. Few flocks are entirely free from them. There are a good many species that infest fowls, all of which are biting lice, hence belong to the order Mallophaga. Lice spend their entire life cycle upon their hosts, an important practical point to consider in their eradication. They are spread by close contact of noninfested fowls with infested ones and by their crawling upon a new host after having been accidentally dislodged from their original host. They are specific in regard to host, although the *Menopum biseriatum* is parasitic for turkeys as well as for chickens. Lice may be found on any feathered part of the fowl, but are generally most common among the fluffy feathers and often congregate around the vent where they go for moisture.

Fortunately poultry lice are not blood suckers. They produce their harmful effects by actively crawling over the host and biting the scales of the skin upon which they feed. Considerable irritation is caused by their activities, resulting in restlessness, decreased production, retarded growth, ragged appearance and emaciation. They rarely cause the death of an adult fowl.

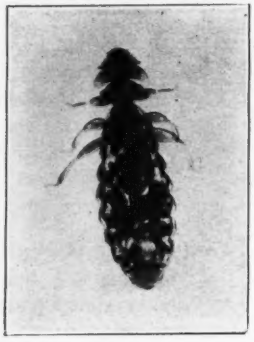
Lousiness in baby chicks presents a somewhat different aspect. Chicks that are hatched in incubators and raised in brooders properly cared for should be free from them and will remain so if kept away from infested fowls and quarters, while henhatched chicks frequently suffer from them, especially in hot seasons. Lice are found on the head, throat, neck and under the wings of infested chicks. The symptoms produced are sleepiness, drooped wings, diarrhea, emaciation, diminished appetite, retarded growth, and in many cases death unless properly and timely treated. Chicks from a few days to two weeks of age suffer most.

Control and Eradication

In regard to eradication, it is desirable to divide the discussion into two parts, one pertaining to the adult and well advanced growing stock, the other having to do with chicks.

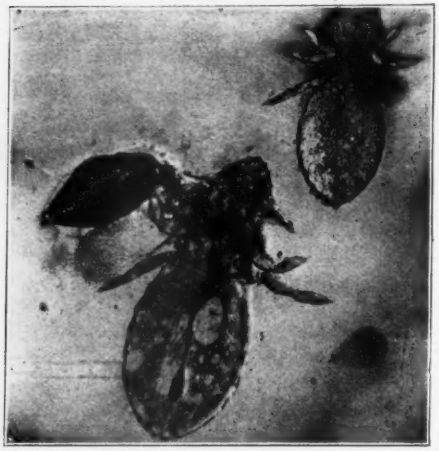
For the first group the use of sodium fluorid, one part to four of wheat flour as a dust powder, is effective. Its effects last

for several days, which affords time for the destruction of young lice that hatch after the treatment has been applied. One



Body Louse of Poultry, Menopon Biseriatum.

application is supposed to suffice, but a representative number of fowls should be examined at the end of ten days; if parasites are



Head and neck louse of poultry—Lipeurus infuscatus—Kaupp. Lice of birds breed and feed, in fact spend their whole life cycle upon the bodies of their hosts. The head and upper part of the neck of birds afford a protective location for lice and they are most likely to be found in these locations.

found the treatment should be repeated. Sodium fluorid is a poison and should be kept from children and pets.

Black leaf 40, a tobacco product, painted on the perch poles a few hours before the fowls go to roost is a simple and effective method of ridding fowls of lice. The fumes destroy the lice on the birds.

In treating baby chicks plain hog lard applied in small quantities to infested parts is effective and comparatively safe. The body of the chicks should not be greased and the use of excessive amounts of the lard should be avoided. It is a good plan not to allow chicks in the direct rays of the hot sun soon after treatment for bad

Hog Louse—Hematopinus Suis (Female).

results may occasionally follow such practice.

Medicated ointments have no advantage over bland oils and ointment bases, and some are harmful.

The mother hen should be treated to prevent re-infestation of the chicks, but care must be exercised that the treatment applied to her does not harm the chicks. In treating both old and young all individuals should be treated at the same time for one infested fowl will soon cause re-infestation of the flock.

Quarters should be frequently and thoroughly cleaned and a suitable parasiticide used. A mixture of kerosene and crude oil is an excellent one. Where practical, dust baths should be arranged and should be exposed as much as possible to the sun. Infested fowls should never be introduced into a clean flock.

Tapeworms in Poultry

By SIVERT ERIKSEN, Kansas City, Missouri

TAPEWORMS, or the general class of cestodes, constitute the most injurious group of parasites in poultry. Tapeworms are so insidious, of such cosmopolitan distribution, have such a wide range of age infectivity and are so difficult to remove that they become undoubtedly the most difficult problem we have to deal with in poultry pathology at the present time. There are a great variety of cestodes infesting poultry; Baylis lists thirty species in his "Manual of Helminthology," which is probably not the entire list.

Types and Classification

It has been found convenient to classify the tapeworms in three main groups based entirely upon size. This classification is used merely to aid in searching for tapeworms when one is conducting an autopsy.

1. Large tapeworms usually measure from eight to twelve inches but may be considerably longer. They usually inhabit the posterior part of the small intestines, and are represented by the following species: *Choanotenia infundibuliformis, Davainea tetragona* and *Davainea cesticillus.*

2. The medium sized tapeworms measure from one to three or four inches and are usually found throughout the middle portion of the intestinal tract, represented by a number of species of Raillietina.

3. The microscopic, or almost microscopic, group are usually located in the anterior part of the small intestines or are deeply burrowed in the mucosa and are frequently difficult to find. The most important representative of this group is *Amebotaenia sphenoides,* and closely followed by *Davainea proglottina.*

These are the most common types of tapeworms.

Description and Life History

The *Choanotenia infundibuliformis* is one of the most common of parasites of poultry. It has a world-wide distribution and attains a length of from fifty to two hundred millimeters (2 to 8 inches). The rostellum bears a single crown of hooks, the genital pores are near the anterior end of the segments and are irregularly alternated. The intermediate host is probably the house fly and possibly other insects.

The *Davainea tetragona,* also classed as *Raillietina tetragona,* is also widely distributed and attains a length up to two hundred and fifty millimeters (10 inches) and has about one hundred rostellum hooks, unilateral genital pores. The intermediate host is the snail and possibly also the house fly.

Davainea cesticillus is widely distributed and attains a length of one hundred and thirty milligrams (4½ inches), has four hundred to five hundred rostellum hooks and alternating genital pores. The intermediate hosts are snails, beetles and possibly house flies.

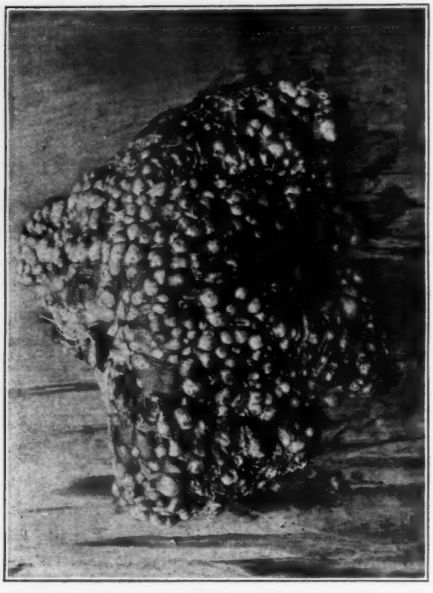
Amebotaenia sphenoides has been found particularly common in the central states during the past two or three years. It is found burrowed deeply in the mucosa of the duodenal loop and measures from two to four millimeters (1/12 to 1/6 of an inch) in length and about one millimeter in breadth. Its rostellum has from twelve to fourteen hooks. It has a peculiar pointed scolex that has an unusually well developed musculature. Under the microscope one can observe a great deal of motility of the various parts of the scolex. The intermediate host is the earth worm.

Davainea proglottina is of very wide distribution. The mature tapeworm consists usually of four or five segments but may have as many as nine and measure one-half to three millimeters (1/50 to 1/8 of an inch) in length and from one-tenth to one-half millimeters in width. The rostellum bears from sixty to ninety-five hooks. The characteristic things about this species is the greatly enlarged posterior segment; this segment is usually as large as the remainder of the parasite. Occasionally the ripe seg-

ments are seen to move shortly after being voided with the droppings. A variety of species of slugs and various snails constitute the intermediate hosts.

Symptoms and Lesions Produced

The large species of tapeworms are most frequently found in older birds and do not produce very characteristic symptoms. Frequently a heavy infestation is found in apparently healthy birds. The medium and microscopic sized tapeworms are more frequently found in growing birds and may be found in mature birds. They produce a progressive emaciation with its accompanying anemia and frequently nervous symptoms such as paralysis and leg weakness. Clinically these cases cannot be differentiated from tuberculosis. The tapeworms are firmly attached to the intestinal mucosa and when they are sufficiently numerous they produce an extensive muco-catarrhal enteritis; this is usually manifested by a diarrhea. The exact relation between tapeworm infestation and so-called range paralysis has not been determined. It seems that a great many cases of so-called paralysis show nothing in the way of gross pathology except muco-catarrhal enteritis due to heavy tapeworm infestation. It is not claimed that all cases of range paralysis are caused by parasites but undoubtedly many of them are.



Liver of swine infested with eichinoccus cysts

On autopsy examination one usually notices the thickened condition of the intestinal wall even before the intestine is opened. This is particularly true with the infestation of microscopic tapeworms in the duodenum. When the intestine is opened the mucosa is found to be greatly thickened and there is a great deal of mucoid exudate. It may be necessary to put some of this exudate on a microscopic slide in order to find the tapeworms. Many of these tapeworms can be detected when some of the mucosa is placed between two slides and flattened. The tapeworms then show up as small white specks or lines which may be confirmed by hand lens or microscope examination. Some of the very slender species may be detected by running a sharp pointed instrument through the mucosa, the fine strands which adhere to this instrument must be identified more definitely since capillaria worms look very much like some of the tapeworms when stretched in this manner.

Treatment of Tapeworm Infestation

The treatment recommended by the Oklahoma Experiment Station several years ago consisting of a boiled mixture of a tablespoonful of lye to a gallon of wheat and oats has been used a great deal. It has not been found entirely satisfactory and with the discovery of kamala as a poultry taenicide the lye treatment has been largely discarded.

Kamala is commonly given in the form of tablets. Twelve to fifteen grains may be used for mature birds, seven and one-half for young growing birds and even less for young chicks, while as high as thirty grains may be given to turkeys. Kamala is quite toxic. If birds are affected with roup or other debilitating conditions one may have a fairly high death rate following the administration of the larger doses of

kamala. It is, therefore, important to examine the birds for various contra-indications and to administer the dose in proportion to the size and the condition of the birds. If there be a doubt as to their condition, dose a half dozen birds first and await results before treating the remainder.

One treatment of kamala tablets is quite effective in removing the large sized tapeworms and has some value in the medium sized species, but it will not remove the microscopic sized species. The latter are extremely difficult to remove. Possibly if the kamala is given in the form of a powder and mixed with the mash so that there is some kamala constantly present in the intestinal tract some of these microscopic tapeworms may be removed and others may be inhibited from developing. We have therefore recommended that kamala powder be mixed with the mash at the rate of forty-five grains to each bird and this fed over a period of a week or ten days. Alkaline treatment to help remove the mucous in the intestines has frequently been employed.

Areca nut is not effective against tapeworms in chickens.

Colloidal preparations of iodin are not satisfactory for the removal of tapeworms.

Prevention and Control

Since tapeworm infestation depends entirely upon the ingestion of the infected intermediate hosts, prevention of tapeworm infestation consists of making it impossible for chickens to consume flies, slugs, snails, earth worms and possibly other species of the lower forms of life that may be intermediate hosts. Ordinarily it is very difficult to accomplish this method of prevention. With the newer methods of battery brooding, keeping poultry on screened floors with screen enclosures the tapeworm problem should become a minor one.

Some poultry raisers make it a practice to collect the droppings daily and place them in screened enclosures so that the intermediate hosts cannot get in contact with possibly infected droppings.

Fly traps undoubtedly are of great value in keeping down the fly menace. Proper location of the poultry yard as to drainage and frequent cultivation will help to reduce the number of common intermediate hosts.

Birds that are badly affected as shown by clinical symptoms should be removed and disposed of since treatment is not apt to remove all the tapeworms in such an individual.

AT THE LOS ANGELES A. V. M. A. MEETING

Three big nights of entertainment.

A program is being planned for veterinary officers, both Regular Army and Reserve. Either a special session or a dinner and an evening program will probably be arranged for this group. It will be a great time for reminiscences of the days of '17 and '18.

Scene on one of the Los Angeles Beaches.

Colosseum at Los Angeles where Olympic Games will be held in 1932.

Entero-Hepatitis or Blackhead in Turkeys

By A. J. DURANT, Columbia, Missouri

THE greatest drawback to the turkey industry of the central states is blackhead. It is estimated that in Missouri 90% of all the turkeys that die, die from this disease. It is not unusual on the ordinary farm where turkeys are allowed to run with chickens to lose the entire spring hatch of anywhere from 100 to 200 poults. A few birds are apparently naturally immune to the disease or acquire an immunity through a light attack of blackhead. These few survivors are the ones which are usually found on the ordinary farms in Missouri.

Cause

The disease is caused by a protozoan parasite known as *Ameba meleagridis* (Smith) or *Histomonas meleagridis* (Tyzzer). It is found in contaminated soil which has been occupied by turkeys or chickens. Chickens, though seldom affected by the disease, are carriers of this parasite and turkeys are more likely to die when running on grounds where chickens have been raised than on grounds where turkeys have run.

The resting stage of the organism lives over from one year to the next unless exposed to zero weather, which apparently kills the parasite. There are two stages of the parasite one of which causes almost immediate development of the disease and the other (the resting stage) in which it takes about 14 or 15 days for the disease to manifest itself. Turkeys which take up the fresh droppings of a bird affected with the disease will develop blackhead quickly, but after the contaminated droppings have been exposed to the air for a few hours, it then requires about fifteen days to develop. Knowledge of these facts may be helpful in the control of the disease.

Symptoms

When poults run on infected grounds it is unusual to see cases of blackhead developing under three or four weeks of age. If poults die before this time one may suspect coccidiosis or some other disease than blackhead. Ordinarily poults will go from four to five weeks before starting to die with blackhead when running on infected grounds. The first intimation of the disease in a flock will be the appearance of a bird which lags behind the others. It becomes droopy and will die within two or three days. Usually new cases rapidly follow the first appearance of a sick bird and an entire flock of poults will soon be decimated unless measures are taken for the control of the disease. A diarrhea usually accompanies the disease but in younger poults this may not be evident. Sometimes in poults five to six weeks of age the golden yellow droppings which are so characteristic of the disease in older birds may be present. However, one should not depend on this symptom in very young birds. In older birds there is nearly always present a golden yellow diarrhea which in Missouri is pathognomonic of blackhead disease. In older birds—birds from four months of age to adults, the disease is more chronic in form and the birds will linger anywhere from a week to a month. Birds affected with the chronic form become thin, weak and their eyes will be sunken and their wings will droop. The accompanying halftone illustrates the appearance of the chronic form of this disease in adults.

Post Mortem Changes

The diagnosis of the disease from a post-mortem examination is comparatively easy. About the only other disease that may be confused with blackhead in adults is tuberculosis. The turkey that dies from blackhead under natural conditions will show marked changes in the two ceca and the liver only. The disease is characterized by the formation of large ulcers on the inner surface of one or both ceca and these ulcers are

found under natural conditions more often toward the apex of the ceca. The ulcers vary in size from a pin head to large ulcers which occupy a majority of the inner surface of the organs. It is not unusual for them to cause perforations of the ceca which result in a chronic peritonitis with adhesions of the ceca to adjacent intestines. The disease develops first in the ceca which furnish a suitable media for the development of this protozoan after the walls of the organs have been irritated by the action of the cecal worm. The parasite is then carried by the blood stream to the liver where it sets up abscesses of this organ, which results in extensive destruction; and, combined with the lesions produced in the ceca, cause the death of the bird. The abscesses of the liver vary in color from a mottled reddish to a dirty yellowish color. They vary in size from minute necrotic areas to large round circular sunken areas an inch or more in diameter. The sunken condition of these abscesses is an important point in differentiating blackhead of the liver from tuberculosis.

Prevention and Control

Since the success of the turkey industry depends on the control of blackhead, the veterinarian will be of far greater service to advise his client how to prevent and control blackhead rather than attempting to treat sick birds after the disease has made heavy inroads into the flock. It is useless for a turkey raiser to attempt to raise turkeys, (unless abligated), on old contaminated grounds, where other turkeys or chickens have been running for the two years past. The poults should be raised on grounds where chickens or turkeys have not been and where the soil has not been contaminated by their droppings. It may happen that the selected grounds will prove to be contaminated, indicated by the appearance of the disease in the flock. When a case of blackhead develops it indicates contamination and it will be necessary to remove the flock to other grounds immediately.

Billings of the Minnesota experiment station has devised a plan of turkey raising which has been very successful. The bulletin is entitled "Talking Turkey" and may be obtained by writing to that station. This is a detailed plan which is useful for professional turkey raisers and will not be used by the ordinary farmer who desires to raise just a few birds at a low cost. If clean grounds are not available for the poults, they may be raised in a brooder house very safely, even on contaminated grounds, providing the brooder house is well bedded with clean wheat straw and kept clean and dry. The author has for three or four years past successfully raised turkeys in a 10 by 12 feet brooder house on contaminated grounds with practically no loss from blackhead. If the turkey raiser desires to raise the turkeys to marketable age only, raised board or wire runs extending out from the brooder house can be constructed very cheaply and the birds successfully raised without their ever coming in contact with contaminated ground.

Any outbreak of blackhead may be controlled and checked within three or four weeks by a practitioner who will give the proper instruction to the turkey raiser. If blackhead appears in a flock it is, as has been mentioned, an indication of infection and it is necessary to move the flock immediately. The birds should be carefully culled and all visibly sick poults removed from the flock and isolated for treatment. The apparently well poults should then be put in a brooder house, the floor of which should be covered with six or eight inches of clean wheat straw and the birds fed a carefully balanced diet containing 3% to 4% of good cod liver oil to prevent rickets. The turkey raiser should be instructed to examine the birds frequently and as often as a new case is found, remove the bird immediately from the brooder house and place it in quarantine for treatment. The straw should then be removed, the house swept out and fresh straw put in. This procedure should be carried out as often as new cases show up. The disease can be checked in this manner in any flock within three or four weeks. The healthy birds may then be put out on clean grounds where turkeys or chickens have not been for two years. Each one of the healthy birds should receive a No. 000 gelatin capsule of turpentine when they are put in the

brooder house and at the end of the quarantine period they should receive two such capsules the day before being put out on clean grounds.

Cecal Abligation as a Control Method

For the benefit of those who desire to raise turkeys in conjunction with the ordinary poultry flocks, cecal abligation, when the poults are three weeks of age, offers a solution for the prevention of blackhead. Though the mortality rate at present is high from the operation itself (an average of 47%) this is not great when one considers that 90% to 100% of young poults will die from the disease when running on infected grounds. The surgical difficulties may soon be overcome so that the mortality rate will be reduced to a practical degree and cecal abligation will become a general practice and will furnish the practitioner a new field for poultry practice. The data on this new discovery will be found in Research Bulletin 133, Missouri Experiment Station, March, 1930, "Blackhead in Turkeys—Surgical Control by Cecal Abligation." This bulletin shows conclusively that an abligated bird will not contract blackhead when running on heavily infected grounds for long periods.

Turkey affected with blackhead in the last stages of the disease. The bird died the day after this picture was taken. Notice the drooping wings and the sunken condition of the eye.

Treatment

There is no specific medicine for the cure of blackhead in turkeys. At the Missouri Experiment Station, Veterinary Department, however, we have been able to cure 62% of birds affected with blackhead by the use of fluid extract of ipecac. This medicine may be administered in two ways, one is to give from twelve to twenty-three drops twice a day in a half to an ounce of water by mouth for four to six days. It may be readily administered with a long nozzle syringe which is easily passed down the throat to avoid strangling. The other treatment consists in the administration of ipecac per vent by means of a two ounce bulb syringe fitted with an eight inch hard rubber nozzle. The nozzle of the syringe containing the medicine should be passed along the floor of the rectum for four to eight inches, depending on the size of the turkey. The bird should be held by the feet with its head down and the medicine gradully expelled so that it will fill up both ceca. Hold the turkey in the same position for about one minute after the medicine is administered. This treatment should be given twice a day for four or five days or until the bird shows signs of recovery. Twenty-three drops to two ounces of water may be safely administered to large turkeys and 15 drops in an ounce of water may be safely administered to small birds twice a day.

Birds that recover should be given a large dose of turpentine the day before they are put out with the rest of the flock. The reason for this is that some birds that recover are carriers of the parasite and will contaminate the grounds on which they run unless this dose of turpentine is given in order to eliminate the parasite from the ceca. The dose for an adult turkey is about a half a dram, though they will tolerate larger amounts. For small turkeys about 15 minims of turpentine is sufficient.

Turkeys that recover from the disease are usually quite resistant to re-infection and are fairly safe from blackhead even when running on contaminated grounds.